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5 G wireless telecommunications expansion: Public health and environmental implications☆

Cindy L. Russell

PO Box 7443, Menlo Park, CA 94026, USA

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ABSTRACT

The popularity, widespread use and increasing dependency on wireless technologies has spawned a telecommunications industrial revolution with increasing public exposure to broader and higher frequencies of the electromagnetic spectrum to transmit data through a variety of devices and infrastructure. On the horizon, a new generation of even shorter high frequency 5G wavelengths is being proposed to power the Internet of Things (IoT). The IoT promises us convenient and easy lifestyles with a massive 5G interconnected telecommunications network, however, the expansion of broadband with shorter wavelength radiofrequency radiation highlights the concern that health and safety issues remain unknown. Controversy continues with regards to harm from current 2G, 3G and 4G wireless technologies. 5G technologies are far less studied for human or environmental effects.

It is argued that the addition of this added high frequency 5G radiation to an already complex mix of lower frequencies, will contribute to a negative public health outcome both from both physical and mental health perspectives.

Radiofrequency radiation (RF) is increasingly being recognized as a new form of environmental pollution. Like other common toxic exposures, the effects of radiofrequency electromagnetic radiation (RF EMR) will be problematic if not impossible to sort out epidemiologically as there no longer remains an unexposed control group. This is especially important considering these effects are likely magnified by synergistic toxic exposures and other common health risk behaviors. Effects can also be non-linear. Because this is the first generation to have cradle-to-grave lifespan exposure to this level of man-made microwave (RF EMR) radiofrequencies, it will be years or decades before the true health consequences are known. Precaution in the roll out of this new technology is strongly indicated.

This article will review relevant electromagnetic frequencies, exposure standards and current scientific literature on the health implications of 2G, 3G, 4G exposure, including some of the available literature on 5G frequencies. The question of what constitutes a public health issue will be raised, as well as the need for a precautionary approach in advancing new wireless technologies.

1. Introduction

The adoption of new 5G technology promises to give the public a transformative communication network with an explosion of speed, volume of data and number of devices with unlimited computing instantly to anyone in the world. High tech companies are already marketing the Internet of Things to businesses, healthcare systems, schools and the public. The promise to connect our phones and appliances, will virtually eliminate many day-to-day household and business functions including driving. This will, according to industry, create a superior, connected society and unprecedented economic growth. What is missing in this discussion is the maturing literature on adverse biological, physiological, and psychological health effects of the 2G, 3G, and 4G radiofrequencies we are already exposed to, in addition to indications from the scientific literature that 5G frequencies could also be hazardous.

Many important but unanswered questions merit serious consideration. Is the widespread deployment of this pervasive higher frequency small cell distributed antennae system in our cities and on our homes safe for humans and the environment? Will it add to the burden of chronic disease that costs our nation, according to the CDC, an estimated 2.3 trillion dollars annually (CDC, 2017)? Are we already digitally over connected, shrinking our gray matter and becoming a dysfunctional addicted nation because of it (Weng et al., 2012)? How

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E-mail address: cindyleerussell@gmail.com.

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Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz GSM base station environmental emission

L. Falcioni, L. Bua, E. Tibaldi, M. Lauriola, L. De Angelis, F. Gnudi, D. Mandrioli, M. Manservigi, F. Manservisi, I. Manzoli, I. Menghetti, R. Montella, S. Panzacchi, D. Sgargi, V. Strollo, A. Vornoli, F. Belpoggi*

Cesare Maltoni Cancer Research Center, Ramazzini Institute, Castello di Bentivoglio, via Saliceto 3, Bentivoglio, 40010 Bologna, Italy

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ABSTRACT

Background: In 2011, IARC classified radiofrequency radiation (RFR) as possible human carcinogen (Group 2B). According to IARC, animals studies, as well as epidemiological ones, showed limited evidence of carcinogenicity. In 2016, the NTP published the first results of its long-term bioassays on near field RFR, reporting increased incidence of malignant glial tumors of the brain and heart Schwannoma in rats exposed to GSM – and CDMA – modulated cell phone RFR. The tumors observed in the NTP study are of the type similar to the ones observed in some epidemiological studies of cell phone users.

Objectives: The Ramazzini Institute (RI) performed a life-span carcinogenic study on Sprague-Dawley rats to evaluate the carcinogenic effects of RFR in the situation of far field, reproducing the environmental exposure to RFR generated by 1.8 GHz GSM antenna of the radio base stations of mobile phone. This is the largest long-term study ever performed in rats on the health effects of RFR, including 2448 animals. In this article, we reported the final results regarding brain and heart tumors.

Methods: Male and female Sprague-Dawley rats were exposed from prenatal life until natural death to a 1.8 GHz GSM far field of 0, 5, 25, 50 V/m with a whole-body exposure for 19 h/day.

Results: A statistically significant increase in the incidence of heart Schwannomas was observed in treated male rats at the highest dose (50 V/m). Furthermore, an increase in the incidence of heart Schwann cells hyperplasia was observed in treated male and female rats at the highest dose (50 V/m), although this was not statistically significant. An increase in the incidence of malignant glial tumors was observed in treated female rats at the highest dose (50 V/m), although not statistically significant.

Conclusions: The RI findings on far field exposure to RFR are consistent with and reinforce the results of the NTP study on near field exposure, as both reported an increase in the incidence of tumors of the brain and heart in RFR-exposed Sprague-Dawley rats. These tumors are of the same histotype of those observed in some epidemiological studies on cell phone users. These experimental studies provide sufficient evidence to call for the re-evaluation of IARC conclusions regarding the carcinogenic potential of RFR in humans.

1. Introduction

Early warnings on the potential carcinogenic risks of mobile phone radiofrequency radiation (RFR) raised in the early 2000 when, for the first time, it was published that people using mobile phones had a significant increased risk to develop vestibular Schwannoma and brain tumors (Hardell et al., 2003, 2002). In 2011, the International Agency for Research on Cancer (IARC) classified RFR as possible human carcinogen (Group 2B) based on limited evidence both in humans and experimental animals (Baan et al., 2011; IARC, 2013). Two epidemiological case-control studies resulted more informative for the IARC evaluation, showing that the risk to develop brain tumors and vestibular Schwannoma was increased in people with the highest cumulative use of mobile phones, in people who had used mobile phones on the

* Corresponding author.
E-mail address: belpoggif@ramazzini.it (F. Belpoggi).

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Impact of radiofrequency radiation on DNA damage and antioxidants in peripheral blood lymphocytes of humans residing in the vicinity of mobile phone base stations

Zothansiama, Mary Zosangzuali, Miriam Lalramdinpuii, and Ganesh Chandra Jagetia

Department of Zoology, Cancer and Radiation Biology Laboratory, Mizoram University, Aizawl, Mizoram, India

ABSTRACT

Radiofrequency radiations (RFRs) emitted by mobile phone base stations have raised concerns on its adverse impact on humans residing in the vicinity of mobile phone base stations. Therefore, the present study was envisaged to evaluate the effect of RFR on the DNA damage and antioxidant status in cultured human peripheral blood lymphocytes (HPBLs) of individuals residing in the vicinity of mobile phone base stations and comparing it with healthy controls. The study groups matched for various demographic data including age, gender, dietary pattern, smoking habit, alcohol consumption, duration of mobile phone use and average daily mobile phone use. The RF power density of the exposed individuals was significantly higher ($p < 0.0001$) when compared to the control group. The HPBLs were cultured and the DNA damage was assessed by cytokinesis blocked micronucleus (MN) assay in the binucleate lymphocytes. The analyses of data from the exposed group ($n = 40$), residing within a perimeter of 80 m of mobile base stations, showed significantly ($p < 0.0001$) higher frequency of micronuclei when compared to the control group, residing 300 m away from the mobile base station/s. The analysis of various antioxidants in the plasma of exposed individuals revealed a significant attrition in glutathione (GSH) concentration ($p < 0.01$), activities of catalase (CAT) ($p < 0.001$) and superoxide dismutase (SOD) ($p < 0.001$) and rise in lipid peroxidation (LOO) when compared to controls. Multiple linear regression analyses revealed a significant association among reduced GSH concentration ($p < 0.05$), CAT ($p < 0.001$) and SOD ($p < 0.001$) activities and elevated MN frequency ($p < 0.001$) and LOO ($p < 0.001$) with increasing RF power density.

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Antioxidants; genotoxicity; humans; micronucleus; power density

Introduction

The mobile phone base stations are one of the essential parts of mobile telecommunication as they transmit the signals in the form of radiofrequency radiations (RFRs) that are received by the mobile phones, acting as a two-way radio, i.e. transceiver (Kwan-Hoong, 2005), generally operating in the frequency range of 900 MHz to 1.9 GHz (Levitt and Lai, 2010). The ever-increasing subscription of mobile phones has led to a phenomenal increase in the mobile phone base stations required to cater to the needs of increasing demand of the mobile subscribers. For decades, there has been an increasing concern on the possible adverse effects of RFR on humans living near mobile phone base stations despite the fact that RFR spectrum are of low frequency (ARPANSA, 2011). There has been a link between the RFR exposures and several human health disorders including cancer, diabetes, cardiovascular and neurological diseases (Bortkiewicz et al., 2004; Eger et al., 2004; Havas, 2013; Lerchl et al., 2015; Wolf and Wolf, 2004). The International Agency for Research on Cancer (IARC, 2011) has classified RFR as a possible carcinogen to humans (group 2B), based on the increased risk for glioma, a malignant type of brain cancer associated with wireless phone use (Hardell et al., 2013).

RFR may change the fidelity of DNA as the increased incidence of cancer has been reported among those residing near mobile phone base stations (Abdel-Rassonl et al., 2007; Bortkiewicz et al., 2004; Cherry, 2000; Eger et al., 2004; Hardell et al., 1999; Hutter et al., 2006; Wolf and Wolf, 2004). RFR emitted from mobile base stations is also reported to increase the DNA strand breaks in lymphocytes of mobile phone users and individuals residing in the vicinity of a mobile base station/s (Gandhi and Anita, 2005; Gandhi et al., 2014). Exposure of human fibroblasts and rat granulosa cells to RFR (1800 MHz, SAR 1.2 or 2 W/kg) has been reported to induce DNA single- and double-strands breaks (Diem et al., 2005). Irreversible DNA damage was also reported in cultured human lens epithelial cells exposed to microwave generated by mobile phones (Sun et al., 2006). The adverse health effects of RFR are still debatable as many studies indicated above have found a positive correlation between the DNA

CONTACT Ganesh Chandra Jagetia gc.jagetia@gmail.com Department of Zoology, Mizoram University, Aizawl 796 004, Mizoram, India.

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Exposure to RF EMF From Array Antennas in 5G Mobile Communication Equipment

BJÖRN THORS[1], DAVIDE COLOMBI[1], ZHINONG YING[2], (Senior Member, IEEE), THOMAS BOLIN[2], AND CHRISTER TÖRNEVIK[1], (Member, IEEE)

[1]Ericsson Research, Ericsson AB, SE-16480 Stockholm, Sweden
[2]Network Technology Laboratory, Research and Technology, Sony Mobile Communications AB, SE-221 88 Lund, Sweden

Corresponding author: B. Thors (bjorn.thors@ericsson.com)

ABSTRACT In this paper, radio-frequency (RF) electromagnetic field (EMF) exposure evaluations are conducted in the frequency range 10–60 GHz for array antennas intended for user equipment (UE) and low-power radio base stations in 5G mobile communication systems. A systematic study based on numerical power density simulations considering effects of frequency, array size, array topology, distance to exposed part of human body, and beam steering range is presented whereby the maximum transmitted power to comply with RF EMF exposure limits specified by the International Commission on Non-Ionizing Radiation Protection, the US Federal Communications Commission, and the Institute of Electrical and Electronics Engineers is determined. The maximum transmitted power is related to the maximum equivalent isotropically radiated power to highlight the relevance of the output power restrictions for a communication channel. A comparison between the simulation and measurement data is provided for a canonical monopole antenna. For small distances, with the antennas transmitting directly toward the human body, it is found that the maximum transmitted power is significantly below the UE power levels used in existing third and fourth generation mobile communication systems. Results for other conceivable exposure scenarios based on technical solutions that could allow for larger output power levels are also discussed. The obtained results constitute valuable information for the design of future mobile communication systems and for the standardization of EMF compliance assessment procedures of 5G devices and equipment.

INDEX TERMS 5G mobile communication, antenna arrays, beam steering, mobile device, mobile user equipment, radio base station, RF EMF exposure.

I. INTRODUCTION

The total amount of mobile traffic is expected to increase dramatically in the coming years [1]. The next generation of wireless access systems (5G), set for commercial availability around 2020 [2], is expected to constitute a key enabler for the larger system capacity and higher data rates of the future. Various research activities are currently ongoing to lay the foundation for this new technology, see e.g. [3], [4], which apart from mobile broadband will involve a range of different use cases and challenging requirements on latency, security, reliability, availability, energy performance, and device cost [5]. In terms of spectrum, 5G systems will need to be able to operate over a very wide frequency range from below 1 GHz up to and including millimeter wave (mmW) frequencies [1]. The available spectrum above 10 GHz will be a key component to fulfill long-term traffic demands and to enable the very wide transmission bandwidths needed to provide the desired multi-Gbps data rates in an efficient manner [5].

Products emitting radio-frequency (RF) electromagnetic fields (EMF) need to be designed and tested to comply with relevant regulatory requirements and limits on human exposure to EMF [6]–[9]. The most widely adopted exposure limits worldwide are the guidelines specified by the International Commission on Non-Ionizing Radiation (ICNIRP) [7] in 1998. In the US, exposure limits specified by the Federal Communications Commission (FCC) are applicable [9]. The exposure limits published by the IEEE [10], [11] are of a more recent date but has so far not been adopted in any national regulations.

For the frequencies used by existing second, third, and fourth generation (2G, 3G, and 4G) mobile communication systems, basic restrictions on RF EMF exposure are specified in terms of the specific absorption rate (*SAR*) to prevent, with wide safety margins, from established adverse health effects associated with excessive localized tissue heating and whole-body heat stress [7], [9], [10]. At higher frequencies,

Biological effects from exposure to electromagnetic radiation emitted by cell tower base stations and other antenna arrays

B. Blake Levitt and Henry Lai

Abstract: The siting of cellular phone base stations and other cellular infrastructure such as roof-mounted antenna arrays, especially in residential neighborhoods, is a contentious subject in land-use regulation. Local resistance from nearby residents and landowners is often based on fears of adverse health effects despite reassurances from telecommunications service providers that international exposure standards will be followed. Both anecdotal reports and some epidemiology studies have found headaches, skin rashes, sleep disturbances, depression, decreased libido, increased rates of suicide, concentration problems, dizziness, memory changes, increased risk of cancer, tremors, and other neurophysiological effects in populations near base stations. The objective of this paper is to review the existing studies of people living or working near cellular infrastructure and other pertinent studies that could apply to long-term, low-level radiofrequency radiation (RFR) exposures. While specific epidemiological research in this area is sparse and contradictory, and such exposures are difficult to quantify given the increasing background levels of RFR from myriad personal consumer products, some research does exist to warrant caution in infrastructure siting. Further epidemiology research that takes total ambient RFR exposures into consideration is warranted. Symptoms reported today may be classic microwave sickness, first described in 1978. Nonionizing electromagnetic fields are among the fastest growing forms of environmental pollution. Some extrapolations can be made from research other than epidemiology regarding biological effects from exposures at levels far below current exposure guidelines.

Key words: radiofrequency radiation (RFR), antenna arrays, cellular phone base stations, microwave sickness, nonionizing electromagnetic fields, environmental pollution.

Résumé : La localisation des stations de base pour téléphones cellulaires et autres infrastructures cellulaires, comme les installations d'antennes sur les toitures, surtout dans les quartiers résidentiels, constitue un sujet litigieux d'utilisation du territoire. La résistance locale de la part des résidents et propriétaires fonciers limitrophes repose souvent sur les craintes d'effets adverses pour la santé, en dépit des réassurances venant des fournisseurs de services de télécommunication, à l'effet qu'ils appliquent les standards internationaux d'exposition. En plus de rapports anecdotiques, certaines études épidémiologiques font état de maux de tête, d'éruption cutanée, de perturbation du sommeil, de dépression, de diminution de libido, d'augmentations du taux de suicide, de problèmes de concentration, de vertiges, d'altération de la mémoire, d'augmentation du risque de cancers, de trémulations et autres effets neurophysiologiques, dans les populations vivant au voisinage des stations de base. Les auteurs révisent ici les études existantes portant sur les gens, vivant ou travaillant près d'infrastructures cellulaires ou autres études pertinentes qui pourraient s'appliquer aux expositions à long terme à la radiation de radiofréquence de faible intensité « RFR ». Bien que la recherche épidémiologique spécifique dans ce domaine soit rare et contradictoire, et que de telles expositions soient difficiles à quantifier compte tenu des degrés croissants du bruit de fond des RFR provenant de produits de myriades de consommateurs personnels, il existe certaines recherches qui justifient la prudence dans l'installation des infrastructures. Les futures études épidémiologiques sont nécessaires afin de prendre en compte la totalité des expositions à la RFR ambiante. Les symptômes rapportés jusqu'ici pourraient correspondre à la maladie classique des micro-ondes, décrite pour la première fois en 1978. Les champs électromagnétiques non-ionisants constituent les formes de pollution environnementale croissant le plus rapidement. On peut effectuer certaines extrapolations à partir de recherches autres qu'épidémiologiques concernant les effets biologiques d'expositions à des degrés bien au-dessous des directives internationales.

Mots-clés : radiofréquence de faible intensité « RFR », les installations d'antennes, des stations de base pour téléphones cellulaires, la maladie classique des micro-ondes, les champs électromagnétiques non-ionisants, pollution environnementale.

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B.B. Levitt.[1] P.O. Box 2014, New Preston, CT 06777, USA.
H. Lai. Department of Bioengineering, Box 355061, University of Washington, Seattle, WA 98195, USA.

[1]Corresponding author (e-mail: blakelevit@cs.com; bbl353355@gmail.com).

Human Exposure to RF Fields in 5G Downlink

Imtiaz Nasim and Seungmo Kim
{in00206, seungmokim}@georgiasouthern.edu
Department of Electrical Engineering, Georgia Southern University
Statesboro, GA 30460, USA

***Abstract*—While cellular communications in millimeter wave (mmW) bands have been attracting significant research interest, their potential harmful impacts on human health are not as significantly studied. Prior research on human exposure to radio frequency (RF) fields in a cellular communications system has been focused on uplink only due to the closer physical contact of a transmitter to a human body. However, this paper claims the necessity of thorough investigation on human exposure to downlink RF fields, as cellular systems deployed in mmW bands will entail (i) deployment of more transmitters due to smaller cell size and (ii) higher concentration of RF energy using a highly directional antenna. In this paper, we present human RF exposure levels in downlink of a Fifth Generation Wireless Systems (5G). Our results show that 5G downlink RF fields generate significantly higher power density (PD) and specific absorption rate (SAR) than a current cellular system. This paper also shows that SAR should also be taken into account for determining human RF exposure in the mmW downlink.**

***Index Terms*—5G; mmW; Downlink; Human RF exposure; PD; SAR.**

I. Introduction

It is acknowledged that exposure to RF has negative impacts on human body. The rapid proliferation of mobile telecommunications has occurred amidst controversy over whether the technology poses a risk to human health [1]. At mmW frequencies where future mobile telecommunications systems will likely operate, two changes that will likely occur have the potential to increase the concern on exposure of human users to RF fields. First, *larger numbers of transmitters* will operate. More base stations (BSs) will be deployed due to proliferation of small cells [2]-[4] and mobile devices accordingly. This will increase chance of human exposure to RF fields. Second, *narrower beams* will be used as a solution for the higher attenuation in higher frequency bands [3]-[7]. Very small wavelengths of mmW signals combined with advances in RF circuits enable very large numbers of miniaturized antennas. These multiple antenna systems can be used to form very high gains. Such higher concentration of RF energy will increase the potential to more deeply penetrate into a human body.

A. Related Work

This paper is motivated from the fact that prior work is not enough to address such potential increase in threats.

1) Measurement of Human RF Exposure: Being aware of the health hazards due to electromagnetic (EM) emissions in mmW spectrum, international agencies such as the Federal Communications Commission (FCC) [8] or the International Commission on Non-Ionizing Radiation Protection (ICNIRP) [9] set the maximum radiation allowed to be introduced in the human body without causing any health concern. Possibilities of skin cancer due to RF emissions at higher frequency spectrum are reported [10]. Heating due to EM exposure in mmW is absorbed within the first few millimeters (mm) within the human skin; for instance, the heat is absorbed within 0.41 mm for 42.5 GHz [11]. The mmW induced burns are more likely to be conventional burns as like as a person touching a hot object as reported in [1]. The normal temperature for the skin outer surface is typically around 30 to 35°C. The pain detection threshold temperature for human skin is approximately 43°C as reported and any temperature over that limit can produce long-term injuries.

One problem is that the literature on the impact of cellular communications on human health is not mature enough. The three major quantities used to measure the intensity and effects of RF exposure are SAR, PD, and the steady state or transient temperature [12][13]. However, selection of an appropriate metric evaluating the human RF exposure still remains controversial. The FCC suggests PD as a metric measuring the human exposure to RF fields generated by devices operating at frequencies higher than 6 GHz [8], whereas a recent study suggested that the PD standard is not efficient to determine the health issues especially when devices are operating very close to human body in mmW [14]. Therefore, this paper examines the human RF exposure by using both PD and SAR.

2) Reduction of Human RF Exposure: Very few prior studies in the literature paid attention to human RF exposure in communications systems [1][14]-[17]. Propagation characteristics at different mmW bands and their thermal effects were investigated for discussion on health effects of RF exposure in mmW radiation [14]. Emission reduction scheme and models for SAR exposure constraints are studied in recent work [15][16].

However, health impacts of mmW RF emissions in *downlink* of a cellular communications system have not been studied so far, which this paper targets to discuss.

B. Contributions

Three contributions of this paper can be highlighted and distinguished from the prior art.

Firstly, this paper analyzes the human RF exposure in the *downlink*. All the prior work studied an uplink only, while paid almost no attention to suppression of RF fields generated by access points (APs) and BSs in a 5G nor Release 9 network,

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healthcare

Brain proteome response following whole body exposure of mice to mobile phone or wireless DECT base radiation

Adamantia F. Fragopoulou[1], Athina Samara[2], Marianna H. Antonelou[1], Anta Xanthopoulou[3], Aggeliki Papadopoulou[3], Konstantinos Vougas[3], Eugenia Koutsogiannopoulou[2], Ema Anastasiadou[2], Dimitrios J. Stravopodis[1], George Th. Tsangaris[3] & Lukas H. Margaritis[1]

[1]Department of Cell Biology and Biophysics, Athens University, Athens, Greece, [2]Genetics and Gene Therapy Division, Center of Basic Research II, Biomedical Research Foundation of the Academy of Athens, Athens, Greece, and [3]Proteomics Research Unit, Center of Basic Research II, Biomedical Research Foundation of the Academy of Athens, Athens, Greece

The objective of this study was to investigate the effects of two sources of electromagnetic fields (EMFs) on the proteome of cerebellum, hippocampus, and frontal lobe in Balb/c mice following long-term whole body irradiation. Three equally divided groups of animals (6 animals/group) were used; the first group was exposed to a typical mobile phone, at a SAR level range of 0.17–0.37 W/kg for 3 h daily for 8 months, the second group was exposed to a wireless DECT base (Digital Enhanced Cordless Telecommunications/Telephone) at a SAR level range of 0.012–0.028 W/kg for 8 h/day also for 8 months and the third group comprised the sham-exposed animals. Comparative proteomics analysis revealed that long-term irradiation from both EMF sources altered significantly ($p < 0.05$) the expression of 143 proteins in total (as low as 0.003 fold downregulation up to 114 fold overexpression). Several neural function related proteins (i.e., Glial Fibrillary Acidic Protein (GFAP), Alpha-synuclein, Glia Maturation Factor beta (GMF), and apolipoprotein E (apoE)), heat shock proteins, and cytoskeletal proteins (i.e., Neurofilaments and tropomodulin) are included in this list as well as proteins of the brain metabolism (i.e., Aspartate aminotransferase, Glutamate dehydrogenase) to nearly all brain regions studied. Western blot analysis on selected proteins confirmed the proteomics data. The observed protein expression changes may be related to brain plasticity alterations, indicative of oxidative stress in the nervous

Authors' contributions: AFF and LHM conceived the concept and design of the experiments, made the literature survey and the final biologically valid interpretation of the EMF impact upon the brain, wrote and finalized the manuscript. AFF carried out all animal handling, welfare, EMF exposure, part of brain dissection and immunoassays. AS performed the brain dissection and brain regions' separation, contributed to the non-EMF writing of the manuscript and together with MHA, EK and EA carried out a part of the immunoassays and contributed to the data evaluation related to neuroproteomics. AX, AP and KV were involved in 2-DE experiments, Maldi ToF/MS, protein identification and statistical analysis. DJS participated in the conception of the design and contributed to the interpretation and evaluation of the overall data. GThT participated in the experimental design and experimental protocols optimization, coordinated the proteomics study, carried out the overall differential proteomics analysis and data evaluation and contributed to the proteomics writing of the manuscript. All authors read and approved the final manuscript.

Address correspondence to Lukas H. Margaritis, Adamantia F. Fragopoulou, Department of Cell Biology and Biophysics, Faculty of Biology, Athens University, Panepistimiopolis, 15784 Athens, Greece. E-mails: lmargar@biol.uoa.gr, madofrag@biol.uoa.gr

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International Appeal: Scientists call for protection from non-ionizing electromagnetic field exposure

An introduction to the International EMF Scientist Appeal

The current issue of the European Journal of Oncology contains a document the "International EMF Scientist Appeal" (EMFscientist.org) that addresses the concerns of 215 scientists from 40 nations about the adverse health effects on the human population exposed to non-ionizing electromagnetic fields (EMF) from extremely-low frequency to radiofrequency. The Appeal has been submitted to the United Nations, to two of its sub-agencies, the World Health Organization (WHO) and the United Nations Environmental Programme (UNEP), and to all UN Member Nations.

We note that the overall weight of evidence reported in peer-reviewed, scientific studies strongly supports greater precautionary measures be taken to reduce or eliminate EMF exposure.

Coordinating and Advisory Committee for the "International EMF Scientist Appeal" (Martin Blank, Magda Havas, Elizabeth Kelley, Henry Lai, and Joel Moskowitz). We can be reached through Elizabeth Kelley at info@EMFscientist.org.

To: His Excellency Ban Ki-moon, Secretary-General of the United Nations;
Honorable Dr. Margaret Chan, Director-General of the World Health Organization; Honorable Achim Steiner, Executive Director of the U.N. Environmental Programme; U.N. Member Nations

Summary. We are scientists engaged in the study of biological and health effects of non-ionizing electromagnetic fields (EMF). Based upon peer-reviewed, published research, we have serious concerns regarding the ubiquitous and increasing exposure to EMF generated by electric and wireless devices. These include–but are not limited to–radiofrequency radiation (RFR) emitting devices, such as cellular and cordless phones and their base stations, Wi-Fi, broadcast antennas, smart meters, and baby monitors as well as electric devices and infra-structures used in the delivery of electricity that generate extremely-low frequency electromagnetic field (ELF EMF).

Scientific basis for our common concerns

Numerous recent scientific publications have shown that EMF affects living organisms at levels well below most international and national guidelines. Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being

in humans. Damage goes well beyond the human race, as there is growing evidence of harmful effects to both plant and animal life.

These findings justify our appeal to the United Nations (UN) and, all member States in the world, to encourage the World Health Organization (WHO) to exert strong leadership in fostering the development of more protective EMF guidelines, encouraging precautionary measures, and educating the public about health risks, particularly risk to children and fetal development. By not taking action, the WHO is failing to fulfill its role as the preeminent international public health agency.

Inadequate non-ionizing EMF international guidelines

The various agencies setting safety standards have failed to impose sufficient guidelines to protect the general public, particularly children who are more vulnerable to the effects of EMF.

The International Commission on Non-Ionizing Radiation Protection (ICNIRP) established in 1998 the "Guidelines For Limiting Exposure To Time-Varying Electric, Magnetic, and Electromagnetic Fields (up to 300 GHz)" (1). These guidelines are accepted by the WHO and numerous countries around the world. The WHO is calling for all nations to adopt the ICNIRP guidelines to encourage international harmonization of standards. In 2009, the ICNIRP released a statement saying that it was reaffirming its 1998 guidelines, as in their opinion, the scientific literature published since that time "has provided no evidence of any adverse effects below the basic restrictions and does not necessitate an immediate revision of its guidance on limiting exposure to high frequency electromagnetic fields (2). ICNIRP continues to the present day to make these assertions, in spite of growing scientific evidence to the contrary. It is our opinion that, because the ICNIRP guidelines do not cover long-term exposure and low-intensity effects, they are insufficient to protect public health.

The WHO adopted the International Agency for Research on Cancer (IARC) classification of extremely low frequency electromagnetic field (ELF EMF) in 2002 (3) and radiofrequency radiation (RFR) in 2011 (4). This classification states that EMF is a *possible human carcinogen (Group 2B)*. Despite both IARC findings, the WHO continues to maintain that there is insufficient evidence to justify lowering these quantitative exposure limits.

Since there is controversy about a rationale for setting standards to avoid adverse health effects, we recommend that the United Nations Environmental Programme (UNEP) convene and fund an independent multidisciplinary committee to explore the pros and cons of alternatives to current practices that could substantially lower human exposures to RF and ELF fields. The deliberations of this group should be conducted in a transparent and impartial way. Although it is essential that industry be involved and cooperate in this process, industry should not be allowed to bias its processes or conclusions. This group should provide their analysis to the UN and the WHO to guide precautionary action.

Collectively we also request that:

1. children and pregnant women be protected;
2. guidelines and regulatory standards be strengthened;
3. manufacturers be encouraged to develop safer technology;
4. utilities responsible for the generation, transmission, distribution, and monitoring of electricity maintain adequate power quality and ensure proper electrical wiring to minimize harmful ground current;
5. the public be fully informed about the potential health risks from electromagnetic energy and taught harm reduction strategies;
6. medical professionals be educated about the biological effects of electromagnetic energy and be provided training on treatment of patients with electromagnetic sensitivity;
7. governments fund training and research on electromagnetic fields and health that is independent of industry and mandate industry cooperation with researchers;

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The human skin as a sub-THz receiver – Does 5G pose a danger to it or not?

Noa Betzalel[a], Paul Ben Ishai[a,b], Yuri Feldman[a,*]

[a] Department of Applied Physics, The Rachel and Selim Benin School of Engineering and Computer Science, The Hebrew University of Jerusalem, Edmond J. Safra Campus, Jerusalem 91904, Israel

[b] Department of Physics, Ariel University, Ariel 40700, Israel

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ABSTRACT

In the interaction of microwave radiation and human beings, the skin is traditionally considered as just an absorbing sponge stratum filled with water. In previous works, we showed that this view is flawed when we demonstrated that the coiled portion of the sweat duct in upper skin layer is regarded as a helical antenna in the sub-THz band. Experimentally we showed that the reflectance of the human skin in the sub-THz region depends on the intensity of perspiration, i.e. sweat duct's conductivity, and correlates with levels of human stress (physical, mental and emotional). Later on, we detected circular dichroism in the reflectance from the skin, a signature of the axial mode of a helical antenna. The full ramifications of what these findings represent in the human condition are still unclear. We also revealed correlation of electrocardiography (ECG) parameters to the sub-THz reflection coefficient of human skin. In a recent work, we developed a unique simulation tool of human skin, taking into account the skin multi-layer structure together with the helical segment of the sweat duct embedded in it. The presence of the sweat duct led to a high specific absorption rate (SAR) of the skin in extremely high frequency band. In this paper, we summarize the physical evidence for this phenomenon and consider its implication for the future exploitation of the electromagnetic spectrum by wireless communication. Starting from July 2016 the US Federal Communications Commission (FCC) has adopted new rules for wireless broadband operations above 24 GHz (5 G). This trend of exploitation is predicted to expand to higher frequencies in the sub-THz region. One must consider the implications of human immersion in the electromagnetic noise, caused by devices working at the very same frequencies as those, to which the sweat duct (as a helical antenna) is most attuned. We are raising a warning flag against the unrestricted use of sub-THz technologies for communication, before the possible consequences for public health are explored.

1. Introduction

The world is galloping towards a bright new future, or at least so industry would like us to think. The advent of 5 G promises unforetold connectivity and unparalleled integration with the virtual world (Agiwal et al., 2016). Technology will interact with almost every aspect of our daily lives (Boccardi et al., 2014), as well as expose us to rich and varied data streaming on our cellular and Wi-Fi devices. While all of this may be true it comes with a price tag. To afford such heavy data traffic we must accept an expansion in data channels (Ben Ishai et al., 2016), something that is not possible in the currently used frequency channels, and an attendant explosion in base stations (Ge et al., 2016). This is the rational to move to 5 G, a FCC standard, which will start at 28 GHz (FCC Report 16–89), soon utilize frequencies up to 60 GHz and may eventually reach the sub - Terahertz range (FCC 50–50 Report).

Industry has assumed that there will be no health risks from this advance (T. Wu et al., 2015a, 2015b) and consequently it has based its planning on the recommendations of the International Commission on Non-Ionizing Radiation Protection (ICNIRP), published in 1998 (Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). International Commission on Non-Ionizing Radiation Protection," 1998). This recommendation limits exposure in the 5 G range to a power density of 10 W/m^2 for the general public and to 50 W/m^2 for occupational exposure ("Guidelines for limiting exposure to time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz). International Commission on Non-Ionizing Radiation Protection," 1998).

However, in recent years concerns have surfaced about possible non-thermal biological effects, and ensuing health issues, arising from cellular electromagnetic radiation (Adams et al., 2014; Blank and Goodman, 2009; Darbandi et al., 2017; Hardell and Sage, 2008; Liu et al., 2013; Panagopoulos, 2017; Sage and Carpenter, 2009; Terzi et al., 2016). These should raise a red flag for the implementation of the 5 G standard. One reason being that the modality of our interaction

* Corresponding author.
E-mail address: yurif@mail.huji.ac.il (Y. Feldman).

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Cancer epidemiology update, following the 2011 IARC evaluation of radiofrequency electromagnetic fields (Monograph 102)☆

Anthony B. Miller[a,*], L. Lloyd Morgan[b], Iris Udasin[c], Devra Lee Davis[d,e]

[a] Dalla Lana School of Public Health, University of Toronto, Canada
[b] Environmental Health Trust, Berkeley, CA, United States
[c] Rutgers University School of Public Health, United States
[d] Environmental Health Trust, Teton Village, WY, United States
[e] Hebrew University of Jerusalem, Israel

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ABSTRACT

Epidemiology studies (case-control, cohort, time trend and case studies) published since the International Agency for Research on Cancer (IARC) 2011 categorization of radiofrequency radiation (RFR) from mobile phones and other wireless devices as a possible human carcinogen (Group 2B) are reviewed and summarized. Glioma is an important human cancer found to be associated with RFR in 9 case-control studies conducted in Sweden and France, as well as in some other countries. Increasing glioma incidence trends have been reported in the UK and other countries. Non-malignant endpoints linked include acoustic neuroma (vestibular Schwannoma) and meningioma. Because they allow more detailed consideration of exposure, case-control studies can be superior to cohort studies or other methods in evaluating potential risks for brain cancer. When considered with recent animal experimental evidence, the recent epidemiological studies strengthen and support the conclusion that RFR should be categorized as carcinogenic to humans (IARC Group 1). Opportunistic epidemiological studies are proposed that can be carried out through cross-sectional analyses of high, medium, and low mobile phone users with respect to hearing, vision, memory, reaction time, and other indicators that can easily be assessed through standardized computer-based tests. As exposure data are not uniformly available, billing records should be used whenever available to corroborate reported exposures.

1. Introduction

With rapidly increasing applications for wireless devices targeting populations of all ages, exposures to the associated radiofrequency radiation (RFR) are increasing in number and diversity. Radiation sources include communications devices such as mobile (cell) or cordless phones, laptops and tablets, baby monitors, wearable devices and associated infrastructure (e.g. routers, antennae on towers, and distributed antennae systems (DAS) that can employ directional couplers or wireless amplifiers to enhance accessibility). Thus, the technology entails direct and growing personal exposures to an expanding array of wireless transmitting devices (WTDs).

In 2011, a Working Group of the World Health Organization's International Agency for Research on Cancer (IARC) classified RFR as a possible human carcinogen (Group 2B) (IARC, 2013). In this paper we review the human epidemiology and some other relevant studies published since the IARC Working Group meeting.

1.1. Wireless phone types

The principal sources of exposure of humans to RFR are cell and cordless phones. The radiated power and technologies for cell phones have evolved over the years, as summarized in Table 1 (Hardell and Carlberg, 2015).

2. Case-control studies; glioma

Aydin et al. (2011) reported the results of CEFALO, a multicenter

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* Corresponding author.
E-mail addresses: ab.miller@utoronto.ca (A.B. Miller), lloyd.l.morgan@gmail.com (L.L. Morgan), iu22@eohsi.rutgers.edu (I. Udasin), ddavis@ehtrust.org (D.L. Davis).

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September 08, 2017

The Honorable Jerry Brown
Governor, State of California
c/o State Capitol, Suite 1173
Sacramento, CA 95814

RE: SB 649 (Hueso) – Small Cell Wireless Facilities

Honorable Governor Brown,

I have recently learned of proposed Bill SB 649 regarding the streamlining of small cell wireless facilities.

As a member of the Physics department of Ariel University, and before that the Hebrew University of Jerusalem, I have studied the subtle effects of electromagnetic radiation on biology and biological materials. I have published more than 50 articles in the field of Dielectrics (the study of the interaction of materials with radio waves), including many on the interaction of cellular frequencies with biological materials such as proteins and blood. My last article investigated the interaction of 5G electromagnetic radiation with human skin.[1] One could argue that I have a certain amount of expertise.

In light of our work and a growing number of publications showing the frequency range of 5G can have serious biological effects, we believe that current efforts to accelerate the implementation of 5G should be delayed until additional studies are made to assess the critical impact on human health.

It is not for me to lecture to elected officials on how cities should develop technologically, nor is it for me to try and stop the juggernaut that is the cellular industry. However, I would like to point out to you important information on the possible public health implications of the explosion in unregulated cellular phone and wireless device use.

The term "health" has never featured too heavily in the lexicon of the Cellular Industry. It has been assumed, conveniently, that any possible effects on the human anatomy from the use of cell phones would be only mild heating. And that this is something that the body could easily deal with. As a consequence, the governing safety limits were set in 1998 by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) based on the premise that if radiofrequency radiation limits protected human tissue from overheating, then the public was adequately protected. They considered that the effect to humans would at most cause the agitation of water inside cellular tissues that would dissipate as heat, similar to what a microwave oven does, but at far lower energies.

The trouble is that our knowledge has progressed in the last 19 years and we now understand that the interaction of microwave energy and our tissues is far more subtle. There is increasing evidence of non-thermal biological consequences arising from our interaction with cellular phone radiation. A few examples; in 2014 a team from the University of Exeter, UK published a report linking the effect of

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+972.3.9066111
Ariel 40700, Israel

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cellular phones on declining sperm quality.[2] They based their research on over 1492 subjects from around the world. In 2009, Columbia University showed that radio frequencies were leading to stress in living cells.[3] This in turn seriously affects their ability to perform, as particular cellular pathways were disrupted. Further evidence along this direction was provided by a group from the University of Rennes.[4] I can add plenty more examples, but I think that it is summed up by a recent public announcement. Advisors to the World Health Organization International Agency for Research on Cancer (WHO/IARC), themselves well versed in radio frequencies and in cancer, have publicly stated that evidence has been met to classify cellular radiation as meeting scientific criteria for a Group 1 carcinogenic agent to humans.[5,6]

As I said above, it is not my job and neither is it realistic for me to stop the placing of thousands of antennas throughout your state. But it is my job to point out the health hazard to you before you make such a momentous decision.

Yours sincerely

Dr. Paul Ben Ishai
Department of Physics
Ariel University

CC
Tom Dyer, Chief Deputy Legislative Affairs Secretary

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+972.3.9066111
Ariel 40700, Israel

Evaluation of the Genotoxicity of Cell Phone Radiofrequency Radiation in Male and Female Rats and Mice Following Subchronic Exposure

Stephanie L. Smith-Roe[1], Michael E. Wyde[1], Matthew D. Stout[1], John W. Winters[2], Cheryl A. Hobbs[2], Kim G. Shepard[2], Amanda S. Green[2], Grace E. Kissling[1], Raymond R. Tice[1], John R. Bucher[1], Kristine L. Witt[1]

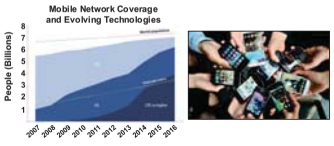
[1]Division of the National Toxicology Program/NIEHS, RTP, NC 27709, USA; [2] Integrated Laboratory Systems, Inc., RTP, NC, 27709, USA

Abstract

The National Toxicology Program tested the two common radiofrequency radiation (RFR) modulations emitted by cellular telephones in a 2-year rodent cancer bioassay that included additional animal cohorts for interim assessments of genotoxicity endpoints. Male and female Sprague Dawley rats and B6C3F1/N mice were exposed from gestation day 5 or postnatal day 35, respectively, to code division multiple access (CDMA) or global system for mobile (GSM) modulations semi-continuously for 18 h/day in 10 min intervals in reverberation chambers at specific absorption rates (SAR) of 1.5, 3, or 6 W/kg (rats) or 2.5, 5, or 10 W/kg (mice). Rats and mice were exposed at 900 MHz or 1900 MHz, respectively. The interim cohorts, 5 animals per treatment group, were examined after 19 (rats) or 13 (mice) weeks of exposure for evidence of RFR-induced genotoxicity. DNA damage was assessed in three brain regions (frontal cortex, hippocampus, and cerebellum), and in liver cells and blood leukocytes using the comet assay. Chromosomal damage was assessed in peripheral blood erythrocytes using the micronucleus assay. DNA damage was significantly increased in the frontal cortex of male mice (both modulations), peripheral leukocytes of female mice (CDMA only), and hippocampus of male rats (CDMA only). DNA damage was nominally elevated in several other tissues of RFR-exposed rats, although statistical significance was not achieved. No significant increases in micronucleated red blood cells were observed in rats or mice. These results suggest that exposure to RFR has the potential to induce measurable DNA damage under certain exposure conditions.

Introduction

- Cellular telephone use is nearly ubiquitous world-wide: cell phone subscriptions were estimated at 6.9 billion in 2014.



- Cell phones transmit radiofrequency radiation (RFR) signals; RFR is a form of electromagnetic radiation.
- Whether exposure to RFR via cell phones can cause cancer, particularly brain cancer, in humans has been of concern. IARC classified radiofrequency electromagnetic fields (RF-EMF), as "possibly carcinogenic to humans (Group 2B)," based on limited evidence in experimental animals and insufficient evidence in humans to support a conclusion on the association between RF-EMF and cancer.
- Results of previous rodent cancer and genotoxicity studies of varying RFR exposures and durations are inconsistent and inconclusive, and many of these studies used experimental protocols with significant limitations. Hence, there is still much uncertainty about the possible adverse effects of RFR, as reflected by the IARC classification.
- The Food and Drug Administration (FDA) Center for Device and Radiation Health nominated Radiofrequency Radiation Emissions of Wireless Communication Devices to the NTP as a high priority nomination in 1999.
- To help inform human health risk assessments, the NTP conducted a 2-year rodent cancer bioassay of the modulations of RFR most commonly emitted by cell phones.
- Genotoxicity testing was conducted using subsets of rats and mice exposed under the same experimental design as the cancer bioassay, albeit for shorter durations.

Study Design, Materials & Methods

Study Design

Male and Female Sprague Dawley Rats (5 rats per exposure group)
- 19 weeks of exposure beginning ~gestational day 5
- 1.5, 3.0, or 6.0 W/kg CDMA or GSM (900 MHz)
- One sham control for each sex

Male and Female B6C3F1/N Mice (5 mice per exposure group)
- 13 weeks of exposure beginning ~postnatal day 35
- 2.5, 5.0, or 10.0 W/kg GSM or CDMA (1900 MHz)
- One sham control for each sex

Whole Body Exposure

Please see Capstick et al. (2017) and Gong et al. (2017) for extensive details

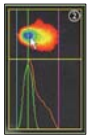
- Daily from 11:00 AM to 2:00 PM and 3:40 PM to 7:00 AM
- RFR cycled on and off every 10 min during exposure periods
  - Total duration of exposure of 9 h 10 min per 24 h period
- An upper limit of 1 °C (1.8 °F) was set as an acceptable increase in body temperature. In 5- and 28-day pilot studies, significant increases in body temperature were rare in rats and mice exposed to 6 or 10 W/kg, respectively (either modulation), and such increases, when they occurred, were < 1 °C. Body temperatue increases > 1 °C were expected to be highly unlikely in this study (Wyde et al., submitted)

RFR Exposure Facility at Illinois Industrial Research Institute (ITRI)

- Reverberation chambers and animal housing were developed in collaboration with the National Institute of Standards and Technology (NIST) and the Foundation for Research on Information Technologies in Society (IT'IS).
- Reverberation chambers created uniform fields of RFR and shielded animals from all other sources of RFR.
- Field uniformity was achieved by installing excitation antennas with rotating horizontal and vertical reflective surface paddles to ensure even distribution of statistically homogenous RFR fields.
- Cages, cage racks, and materials used to deliver food and water were designed to minimize interference with RFR exposure; e.g., specialized lixits were developed to prevent drinking tubes from acting as antennas for RFR.
- RFR field intensity, uniformity, quality of modulation, and numerous other parameters were validated by NIST.
- Consistency of exposure was monitored in real time by IT'IS.

Comet Assay

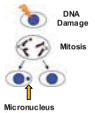
Frontal cortex, hippocampus, cerebellum, liver, and peripheral blood were analyzed in the comet assay. Single-cell suspensions were diluted in agarose and layered onto CometSlides™. Slides were incubated overnight in lysing solution at 4 °C, then treated with cold alkali solution for 20 min to allow DNA unwinding. Slides were then subjected to electrophoresis for 20 min. After staining with SYBR® Gold, slides were coded to mask treatment and scored using Comet Assay IV Imaging Software. DNA migration was measured in 100 non-overlapping comet images per animal/tissue and reported as % Tail DNA. Hedgehogs (HH; all DNA appears by visual inspection to be in the tail) were scored as a separate category.



Comet Assay IV imaging software identifies the left edge of the head of the comet and flips it to construct the right edge. % Tail DNA is calculated by dividing the fluorescence intensity of the tail by the total fluorescence intensity of the entire comet figure.

Micronucleus Assay

Flow cytometric analysis was performed using MicroFlow^{PLUS} Kit reagents and a FACSCalibur™ system. Reticulocytes (RET) and mature erythrocytes (E) were analyzed for micronuclei (MN). For each sample, ~20,000 RET were analyzed and ~1 x 10^6 mature erythrocytes were enumerated concurrently, allowing for calculation of the %RET among total erythrocytes as a measure of bone marrow toxicity. The protocol was consistent with OECD Guideline 474.



Micronucleus (broken chromosomes or whole chromosome loss)

Results for MN-RETs, MN-Es, and %PCEs were negative for both species, both sexes, and both RFR modulations (data not shown).

Figure 1

Two Approaches for Scoring Comets

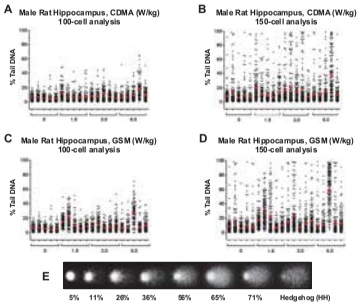


Fig. 1A, C: Comets were selected by a scorer (blind to treatment) for analysis *via* software to determine % Tail DNA. 100 cells were analyzed per animal/tissue and HH – identified by visual inspection – were tabulated but excluded from analysis. However, using this approach, % Tail DNA rarely exceeded 65%, yet for some tissues %HH values were markedly elevated. **Fig. 1B, D**: OECD TG 489 (OECD, 2014) recommends analyzing 150 cells. To be consistent with this new recommendation, and due to inter-animal variability observed in rats, rat slides were re-analyzed using this method; all scorable cells were analyzed with imaging software (i.e., visual inspection alone was not used to eliminate HH). This approach revealed a broader spectrum of DNA damage (Fig. 1B & D). There were few changes in statistically significant results based on scoring 100 vs. 150 cells. **Fig. 1E**: Representative images of DNA migration in the comet assay (% Tail DNA) from male rat frontal cortex.

Figure 2

Positive Results

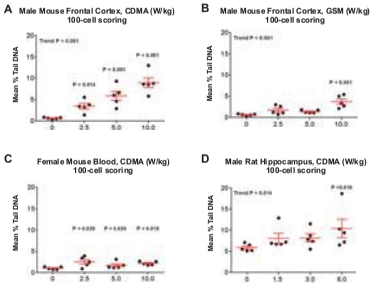
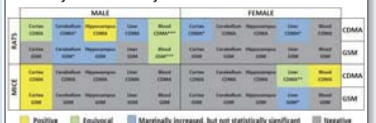


Fig. 2A-D: Of the 40 tissues examined (5 tissues, 2 species, 2 sexes, 2 modulations) using the 100-cell scoring approach, 4 showed positive results using the following criteria: significant trend test ($P < 0.025$) and at least one significant dose group ($P < 0.025$); or at least 2 significant dose groups. Similar results were obtained for these tissues when data were analyzed using the 150-cell method except for male rat hippocampus (means of all exposed groups were greater than the control, but did not reach statistical significance).

Tissues from rats tended to show greater inter-animal variability than those from mice. This inter-animal variability may reflect the genetic diversity of this outbred rat stock. However, % Tail DNA values from different tissues from the same rat rarely correlated, suggesting inter-tissue variability as well.

Figure 3

Summary of Comet Assay Results



Positive: Significant trend test ($P < 0.025$) and at least one significant dose group ($P < 0.025$); or at least 2 significant dose groups. **Equivocal**: Either a significant trend test or one significant dose group. **Marginally increased**: Means of all exposed groups were higher than the control and P values approached statistical significance. **Negative**: none of the above.

In summary, 8/40 tissues exhibited some degree of effect from RFR exposure when assessed using the 100-cell scoring approach. Five tissues exhibited marginal, but statistically non-significant increases when assessed using the 150-cell scoring approach (*). Female mouse liver (CDMA) went from marginal to an equivocal call using the 150-cell scoring approach (**). Two tissues, male rat blood (CDMA and GSM), went from negative to equivocal calls using the 150-cell scoring approach (***).

Conclusions

- When considering both scoring methods, 15/40 of the tissues examined showed some indication of response (positive, equivocal, or increases in % Tail DNA in the absence of statistical significance) in the comet assay. The comet assay is a hazard identification assay, and the damage detected by the assay represents a snapshot of the kinetics of DNA damage and repair processes.
- In the 2-year bioassay, a low incidence of malignant gliomas of the brain was observed in male, but not female, rats exposed to CDMA or GSM in the 2-year cancer bioassay (Wyde et al. 2016). Results are not yet available for mice. Considering that male rat brain tissue was more affected by RFR in the comet assay compared to female rats and male and female mice, it will be of interest to see whether there is a correlation between the comet assay results and the complete findings from the cancer bioassay.
- High exposure levels of RFR can cause hyperthermia in rats and mice, and hyperthermia is known to cause genotoxic effects in both the comet and micronucleus assays; however, the exposures used in the 2-year cancer bioassay (and therefore the genetic toxicity studies) were carefully selected, based on pilot study data, to avoid thermal effects.
- The mechanism by which RFR could induce biological effects other than by increasing body temperature is a matter of intense speculation. The NTP is currently in the process of acquiring smaller RFR whole body exposure chambers for follow-up studies. Initial studies will aim to explore potential mechanisms underlying the observed DNA damage in the comet assay and explore other biomarkers of genetic damage.

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Wyde et al. (submitted) Design and validation of the National Toxicology Program's Cell Phone Radiofrequency Radiation Reverberation Chamber Exposure System. *Bioelectromagnetics.*

Dependence of non-thermal biological effects of microwaves on physical and biological variables: implications for reproducibility and safety standards

Igor Y Belyaev
Laboratory of Molecular Genetics, Cancer Research Institute, Bratislava, Slovak Republic
Laboratory of Radiobiology, General Physics Institute, Russian Academy of Science, Moscow, Russia
Department of Genetic and Cellular Toxicology, Stockholm University, Stockholm, Sweden

Abstract

Diverse biological responses, including adverse health effects, to non-thermal (NT) microwaves (MW) have been described by many research groups all over the world. The aim of this paper is to provide an overview of the complex dependence of these effects on various physical and biological parameters, which must be controlled in replication studies.
Besides well-known dependencies on carrier frequency and modulation, emerging data suggest dependencies of NT MW effects on polarization, intermittence and coherence time of exposure, static magnetic field, electromagnetic stray fields, genotype, gender, physiological and individual traits, cell density during exposure. Data also indicate that duration of exposure may be as important as power density (PD) and specific absorption rate (SAR). Further evaluation of these dependencies are needed for understanding the mechanisms by which NT MW affect biological systems, planning *in vivo* and epidemiological studies, developing medical treatments, setting safety standards, and minimizing the adverse effects of MW from mobile communication.

***Key words*: non-thermal effects of microwaves, mobile (cellular) phones, safety standards.**

List of abbreviations:
Anomalous viscosity time dependence (AVTD); blood-brain barrier (BBB); catalase (CAT); Digital Enhanced (former European) Cordless Telecommunications (DECT); circularly polarized (CP); continuous wave (CW); Digital Advanced Mobile Phone System (DAMPS); discontinuous transmission (DTX); electroencephalographic (EEG); electromagnetic field (EMF); embryonic stem (ES) cells; ethidium bromide (EtBr); extremely low frequency (ELF); Gaussian Minimum Shift Keying (GMSK); Ginkgo biloba (Gb); Global System for Mobile Communication (GSM); glutathione peroxidase (GSH-Px); International Commission for Non-Ionizing Radiation Protection (ICNIRP); linearly polarized (LP); malondialdehyde (MDA); micronucleus (MN) assay; microwaves (MWs); N-acetyl-beta-d-glucosaminidase (NAG); nitric oxide (NO); non-thermal (NT); ornithine decarboxylase (ODC); phorbol ester 12-myristate 13-acetate (PMA); phosphorylated H2AX histone (γ-H2AX); power density (PD);

Address: Igor Y Belyaev, Ph D, D Sc. Cancer Research Institute, Slovak Academy of Sciences, Vlárska 7, 833 91 Bratislava, Slovak Republic - Tel: +421 259327322 - Fax: +421 259327305
E-mail: Igor.Belyaev@gmt.su.se

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Toxicology and cellular mechanisms of electromagnetic fields (EMF)-Health aspects of exposure to EMF Emitted by wireless mobile systems and emerging technologies

S12-01
Two-year oncogenicity evaluations of cell phone radiofrequency radiation in Sprague-Dawley rats and B6C3F1 mice

David McCormick

IIT Research Institute, Chicago, IL, United States

Epidemiology data concerning possible health effects of exposure to radiofrequency fields (RF) are conflicting. For this reason, well-designed and controlled studies in predictive laboratory animal models provide the best prospective opportunity to identify effects of RF exposure that may translate into human health hazards. The U.S. National Toxicology Program supported a program in our laboratory to identify and characterize effects of acute, subchronic, and chronic exposure to non-thermal levels of RF in Sprague-Dawley rats and B6C3F1 mice. Five-day pilot studies were performed to identify the maximum Specific Absorption Ratios (SARs) to which juvenile, adult, and pregnant rodents can be exposed without increasing body temperature by >1.0 °C. Subsequent subchronic (ten-week) toxicity studies failed to identify any toxicologically significant effects of non-thermal RF on survival, body weight, clinical signs, hematology, or gross or microscopic pathology. Two-year studies were performed to determine if exposure to non-thermal levels of RF increases the incidence of neoplasia in any site. Male rats exposed to RF demonstrated significantly increased incidences of glioma (brain) and schwannoma (heart); these increases were not seen in female rats or in either sex of mice. Gliomas and schwannomas have been identified in some epidemiology studies as possible RF-induced neoplasms. Considering (a) the conflicting results of RF epidemiology studies and (b) the lack of generally accepted biophysical or molecular mechanisms through which RF could induce or promote neoplasia, data from animal bioassays will play a central role in "weight-of-the-evidence" assessments of the possible health effects of RF exposure.

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Wi-Fi is an important threat to human health☆

Martin L. Pall

Washington State University, 638 NE 41st Avenue, Portland, OR 97232-3312, USA

ARTICLE INFO

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Activation of voltage-gated calcium channels
Wi-Fi or WiFi

ABSTRACT

Repeated Wi-Fi studies show that Wi-Fi causes oxidative stress, sperm/testicular damage, neuropsychiatric effects including EEG changes, apoptosis, cellular DNA damage, endocrine changes, and calcium overload. Each of these effects are also caused by exposures to other microwave frequency EMFs, with each such effect being documented in from 10 to 16 reviews. Therefore, each of these seven EMF effects are established effects of Wi-Fi and of other microwave frequency EMFs. Each of these seven is also produced by downstream effects of the main action of such EMFs, voltage-gated calcium channel (VGCC) activation. While VGCC activation via EMF interaction with the VGCC voltage sensor seems to be the predominant mechanism of action of EMFs, other mechanisms appear to have minor roles. Minor roles include activation of other voltage-gated ion channels, calcium cyclotron resonance and the geomagnetic magnetoreception mechanism. Five properties of non-thermal EMF effects are discussed. These are that pulsed EMFs are, in most cases, more active than are non-pulsed EMFs; artificial EMFs are polarized and such polarized EMFs are much more active than non-polarized EMFs; dose-response curves are non-linear and non-monotone; EMF effects are often cumulative; and EMFs may impact young people more than adults. These general findings and data presented earlier on Wi-Fi effects were used to assess the Foster and Moulder (F&M) review of Wi-Fi. The F&M study claimed that there were seven important studies of Wi-Fi that each showed no effect. However, none of these were Wi-Fi studies, with each differing from genuine Wi-Fi in three distinct ways. F&M could, at most conclude that there was no statistically significant evidence of an effect. The tiny numbers studied in each of these seven F&M-linked studies show that each of them lack power to make any substantive conclusions. In conclusion, there are seven repeatedly found Wi-Fi effects which have also been shown to be caused by other similar EMF exposures. Each of the seven should be considered, therefore, as established effects of Wi-Fi.

1. Introduction

Wi-Fi (also known as WiFi or WLAN) is a wireless network involving at least one Wi-Fi antenna connected to the internet and a series of computers, laptops and/or other wireless devices communicating wirelessly with the Wi-Fi antenna. In this way, each such wireless communication device can communicate wirelessly with the internet. All the studies reviewed here were of Wi-Fi using the 2.4 GHz band, although there is also a 5 GHz band reserved for possible Wi-Fi use.

Telecommunications industry-linked individuals and groups have claimed that there are no and cannot possibly be any health impacts of Wi-Fi (Foster and Moulder, 2013; Berezow and Bloom, 2017). However with Wi-Fi exposures becoming more and more common and with many of our exposures being without our consent, there is much concern about possible Wi-Fi health effects. This paper is not focused on anecdotal reports but rather on 23 controlled, scientific studies of such health-related effects in animals, cells including human cells in culture and in human beings (Table 1).

Each of the effects reported above in from 2 to 11 studies, have an extensive literature for their occurrence in response to various other non-thermal microwave frequency EMFs, discussed in detail below. These include (see Table 1) findings that Wi-Fi exposures produce impacts on the testis leading to lowered male fertility; oxidative stress; apoptosis (a process that has an important causal role in neurodegenerative disease); cellular DNA damage (a process causing cancer and germ line mutations); neuropsychiatric changes including EEG changes; hormonal changes.

The discussion here focuses on those Wi-Fi effects which have been found by multiple Wi-Fi studies and have been previously confirmed by non-thermal exposures to other microwave frequency EMFs. The 1971/72 U.S. Office of Naval Medical Research study (Glaser, 1971) reported the following changes related to testis or sperm: 1. Decreased testosterone leading to lowered testis size. 2. Histological changes in testicular epithelial structure. 3. Gross testicular histological changes. 4.

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E-mail address: martin_pall@wsu.edu.

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June 26, 2017

The Honorable Cecilia Agular-Curry, Chair
Assembly Local Gov't Commission
Room 157, 1020 N Street
Sacramento, CA 95814

RE: SB 649 (Hueso) – Small Cell Wireless Facilities - -OPPOSE

Dear Chair Agular-Curry:

Environmental Working Group (EWG) opposes SB 649 by Senator Hueso. This bill would make the installation of small cell wireless facilities, such as those used to facilitate 5G networks, ministerial rather than discretionary at the local government level.

The health impacts of cellular transmissions have been debated more and more passionately the last ten years because there are studies that raise real concerns about the effects of radio frequency (RF) energy or radiation on humans. This is why EWG sponsored two bills by former Senator Leno (SB 1212 in 2010 and SB 932 in 2011) that would have required sellers of cell phones to inform consumers that minimizing exposure to cell phone radiation is prudent and in fact recommended by cell phone manufacturers in their included manuals.

Studies on the health impacts of cell phones and their transmission infrastructure are continuing. As new information becomes available, local government ought to be able to use it to help guide their decision-making, including locational issues such as proximity to homes, school, and hospitals. EWG believes that allowing cities and counties to weigh the potential impacts of transmission networks before permits are issued for their construction is essential and SB 649 would prevent them from doing so. And, if more definitive health concerns arise, state law would have to be changed in order to give local governments the flexiblity to do their due diligence.

For these reasons, we must oppose SB 649 and urge a "no" vote in the Local Government Committee.

Sincerely,

Bill Allayaud

Bill Allayaud
California Director of Government Affairs
Environmental Working Group

cc: Senator Hueso

SB 649 Would Eliminate the Ability of Communities to Promote their Interests and Priorities.

It is important to remember that the rights-of-way that providers use to build out their networks are **owned by communities and managed by municipalities**.[1] Currently, if a phone or broadband provider wants access to a local community's right-of-way, it can negotiate with that community for a franchise, paying fair-market value for that access. Additionally, communities can currently negotiate with providers to advance community priorities and interests in exchange for access to community-owned rights of way. For example, if a provider seeks access to build out its network in a high-income area, a community could grant access to that in exchange for that providers' providing high-speed broadband to anchor institutions in lower-income areas. SB 649 would eliminate communities' ability to manage their rights-of-way, unduly interfering with those communities' right to self-determination.

SB 649 Would Allow Providers to Use Community-Owned Property without Paying Just Compensation.

Phone and broadband providers already reap windfall profits from Californians. SB 649 limits communities to charging set prices and fees for access to their rights-of-way. These artificial restrictions distort the market and force consumers to subsidize providers' costs. SB 649 prevents communities from getting full market value in exchange for access to rights-of-way. Accordingly, SB 649 increases the power of providers to extract profits from local communities that already face monopoly or near-monopoly prices.

Greenlining supports any legislative measure that increases the availability of advanced communications services to communities of color. Unfortunately, SB 649 is not such a measure. The bill promises to widen the digital divide, place control over community-owned property in the hands of providers, and fail to compensate communities fairly. Accordingly, Greenlining OPPOSES SB 649.

If you have any questions, please do not hesitate to contact me.

Sincerely,

Stephanie Chen
Energy & Telecommunications Policy Director

[1] Frederick E. Ellrodd III & Nicholas P. Miller, Property Rights, Federalism, and Public Rights-of-Way (2003) 26 Seattle Univ. Law. Rev. 475, 477.

Alliance of Nurses for Healthy Environments

June 26, 2017

The Honorable Cecilia Agular-Curry,
Chair Assembly Local Gov't Commission
Room 157, 1020 N Street Sacramento,
CA 95814

RE: SB 649 (Hueso) – Small Cell Wireless Facilities - - OPPOSE

Dear Chair Agular-Curry:

I am a Professor of Public Health at the University of San Francisco and a Board Member of the national Alliance of Nurses for Healthy Environments. I am very concerned about moving forward with expanding the use of small-scale wireless technologies at the same time that there is mounting evidence of the potential for health risks from the associated radio frequency energy and radiation, particularly to children. The Alliance of Nurses for Healthy Environments ascribes to the precautionary principle as it applies to human health. We firmly believe that early warnings in the scientific literature should be heeded and that our policy development should reflect the synthesis of the best and latest scientific evidence.

At this point in time, we oppose SB 649 and believe that we need an exhaustive review of the science before we allow significant expansion of small cell wireless facilities, such as those to facilitate 5G networks. The results of the literature review should inform our policies. We must be sure that vulnerable populations such as pregnant women and young children will not be unduly harmed from their proximity to unnecessary radio frequency energy. It is important that we continue to examine what constitutes a safe distance and how we can continue to pivot when more information becomes available. We are concerned that the passage of SB 649 will entrench us in a policy for which we have insufficient assurances and which, if passed, will require the burden of effort to reverse.

For these reasons, we oppose SB 649 and urge a "no" vote in the Local Government Committee.

Thank you for considering our concerns.

Sincerely,

Barbara Sattler, RN, MPH, DrPH, FAAN
Board Member

August 15, 2017

The Honorable Cecilia Aguiar-Curry
Chair, Assembly Local Government Committee
State Capitol Building, Room 5144
Sacramento, CA 95814

SB 649 (Hueso)- Wireless Telecommunications Facilities- OPPOSE

Chair Aguiar-Curry,

On behalf of the undersigned, we write to register our opposition to SB 649 (Hueso) which would prohibit local discretionary review of "small cell" wireless antennas , including equipment collocated on existing structures or located on new "poles, structures, or non-pole structures," including those within the public right-of-way and buildings. The proposal preempts adopted local land use plans by mandating that "small cells" be allowed in all zones as a use by-right, including all residential zones. Because of this, this proposal essentially provides a CEQA exemption for installation of these facilities, undermining the ability for communities to comment and register their concerns associated with previously mentioned installation. These "small cell" installations not only can cause an aesthetic blight, but can release levels of radiation that we don't yet know conclusively the health impacts they can impose of humans, especially developing bodies and minds of children. These small cell boxes could pop up anywhere: grocery stores, outside school, playgrounds, communal places, with no requirement to mitigate effects or understand potential environmental and health hazards.

For these reasons, we urge your "no" vote in committee.

Thank you,

Jena Price, Legislative Affairs Manager
California League of Conservation Voters

Kyle Jones, Legislative Associate
Sierra Club California

Jane Williams, Executive Director
California Communities Against Toxics

ENVIRONMENTAL HEALTH TRUST
892 Arlington Av. Berkeley, CA, 94707 (307) 200-9358
www.ehtrust.org

June 28, 2017

The Honorable Cecilia Aguiar-Curry
Chair of the Local Government Committee
1020 N Street, Room 157
Sacramento, CA 95814

RE: SB 649 (Hueso) – Small Cell Wireless Facilities — OPPOSE

Dear Chair Aguiar-Curry:

As a nonprofit research and policy organization dedicated to identifying and reducing environmental health hazards, Environmental Health Trust (EHT) writes to advise you of serious scientific grounds to reject SB 649 as advanced by Senator Hueso. I have personally served as an expert advisor to the California Department of Health as well as the San Francisco and Berkeley City governments on matters relevant to this bill. EHT has been honored to work with California government and scientists for over a decade. At the invitation of the Israel Institute for Advanced Study of the Hebrew University of Jerusalem, EHT recently organized and chaired an Expert Forum on Wireless Radiation and Health, bringing together scientists and engineers from more than ten high tech nations. Reflecting these efforts, EHT provides independent scientific research and advice on avoidable environmental health hazards to local, state and national governments.

SB 649 will pave the way for widespread introduction of 5G microwave wireless radiation frequency (RF) that has never been tested for its impact of public health or the environment. Other RF microwave radiation such as that used by cellphones and other wireless devices has been classified as a 'possible carcinogen' by the International Agency for Research on Cancer in 2011 and more recently dubbed a 'probable carcinogen,' by expert researchers looking at newer information in 2015.[1, 2, 3] In addition, this bill could result in the loss of hundreds of millions of dollars in local revenue, as the San Francisco Chronicle noted today.

By ignoring growing scientific evidence of harm, the bill effectively will ensure the widespread exposures of millions of Californians to an agent that growing numbers of scientists and nations consider a serious

[1] World Health Organization. "IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans," WHO, Press Release, no. 208, 2011.
[2] IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. "Non-ionizing radiation, Part 2: Radiofrequency electromagnetic fields." *IARC Monographs On The Evaluation of Carcinogenic Risks to Humans*, vol. 102, pt. 2, 2013.
[3] Morgan, L. Lloyd, et al. "Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen (2A)." *International Journal of Oncology,* vol. 46, no. 5, 2015, 1865-71.

health threat. Recently, studies have found that the frequencies which will be used in 5G and other future technologies can have harmful effects[4], as Dr. Cindy Russell, Vice President of Community Health for the Santa Clara Medical Association noted.[5] As articulated in their state Constitution, California cities and counties have a duty to protect the health and safety of their residents.

EHT has a longstanding history of research and policy advice to state, local and national governments regarding strategies to reduce disease and promote health by avoiding environmental health hazards. Our organization opposes the broad scale installation of untested wireless antennas and associated electrical equipment close to humans and through critical wildlife habitat and corridors. Both federal and local zoning controls are needed to assure that cellular equipment are installed to avoid significant and serious safety threats of electrical shock, fire, and radio frequency (RF) microwave radiation exposures, as well as chronic impacts on public health and the environment.

Consistent with public health concepts of preventing harm by reducing exposure to suspected carcinogens, EHT opposes the usurpation and preemption of local authority that will allow federal and state authorities to place what state reports of the bill indicate can be thirty thousand new radiating 5G cell antennas on city and county utility, light poles, and other right of ways in close proximity to city and county workers, children, residents and visitors. In some cases towers will need to be sited every 100 feet with antennas at a height of 30 feet or less. Local authority and duty should not be overridden by preemptive federal or state policies such as SB 649 which disregards scientific evidence on this matter as outlined below.

Regarding potential health risks from RF a number of corporations advise their shareholders that they face serious risks from RF. For instance, Crown Castle's 2016 10-K ANNUAL REPORT, states that,

> *"If radio frequency emissions from wireless handsets or equipment on our wireless infrastructure are demonstrated to cause negative health effects, potential future claims could adversely affect our operations, costs or revenues. The potential connection between radio frequency emissions and certain negative health effects, including some forms of cancer, has been the subject of substantial study by the scientific community in recent years. We cannot guarantee that claims relating to radio frequency emissions will not arise in the future or that the results of such studies will not be adverse to us...If a connection between radio frequency emissions and possible negative health effects were established, our operations, costs, or revenues may be materially and adversely affected. We currently do not maintain any significant insurance with respect to these matters."*

Most wireless companies from AT&T to Nokia to T Mobile to Verizon Wireless have issued similar warnings to their shareholders.

Regarding public health impacts, recently released research findings from the premiere test program of the National Institute of Environmental Health Sciences (NIEHS) add to the body of scientific evidence

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[4] Feldman, Yuri, et al. "Human Skin as Arrays of Helical Antennas in the Millimeter and Submillimeter Wave Range." *Physical Review Letters*, vol. 100, no. 128102, 2008.

[5] Russell, Cindy. "A 5G Wireless Future: Will it give us a Smart Nation or Contribute to an Unhealthy One?" Santa Clara Bulletin, Jan./Feb. 2017.

indicating that RF microwave radiation can be harmful. The 10 year $25 million NIEHS National Toxicology Program's Studies of the Toxicology and Carcinogenicity Cell Phone Radiation reports that RF produced increases rates of highly malignant very rare tumors: gliomas of the brain and schwannomas of the heart.[6] These experimental findings are consistent with human studies showing increased rates of gliomas and acoustic neuromas (schwann cells) among humans exposed to cell phone radiation. In addition to increased cancers, the NTP study also reported that prenatally exposed animals produced offspring with lower birth weight and evidence of direct genetic damage.

Since the 2011 WHO/IARC classification, the peer reviewed research connecting microwave exposure to cancer has significantly strengthened. In 2015, a study replicated a 2010 experiment that found that weak cell phone signals significantly promote the growth of tumors in mice, and that toxic chemical exposures combine with RF to more than double the tumor response.[7,8] The Ramazzini Institute is engaged in similar research with RF that is 1000 less than the NTP exposures—set to mimic radiation exposure levels caused by network equipment (e.g., cell tower antenna emissions).

Consistent with the NTP findings, the Ramazzini Institute team report significantly lower litter weights, as presented at the January 2017 Conference on Wireless and Health at Israel Institute for Advanced Study, Hebrew University of Jerusalem.[9] Findings of effects at such low levels is indication of the capability of low level electromagnetic radiation exposure to result in biological effects.

Other studies finding serious increased risk of glioma in regular cell phone users are of special relevance. In 2014, a French national study linked higher cell phone exposure to increased glioma in cell phone users.[10] A newly published research report in the *American Journal of Epidemiology* finds that Canadians who have used cell phones for 558 hours or more have more than a doubled risk of brain cancer.[11] Previous published re-analysis of the multi country Interphone study data has found stronger positive associations to glioma risk among long term users and heavy users and a statistically significant association between where tumors were located and how much radiation an individual received from their phone.[12,13]

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[6] Wyde, Michael, et al. "Report of Partial findings from the National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley® SD rats (Whole Body Exposure)." *bioRxiv,* no. 055699, 2016.

[7] Lerchl, Alexander, et al. "Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans." *Biochemical and Biophysical Research Communications,* vol. 459, no. 4, 2015, pp. 585-90.

[8] Tillmann, Thomas, et al. "Indication of cocarcinogenic potential of chronic UMTS-modulated radiofrequency exposure in an ethylnitrosourea mouse model." *International Journal of Radiation Biology,* vol. 86, no. 7, 2010, pp. 529-41.

[9] Belpoggi, Fiorella. "Recent findings on wireless radiation and health from the Ramazzini Institute could reinforce the NTP results." *Conference on Wireless and Health*, 2017.

[10] Coureau, Gaëlle, et al. "Mobile phone use and brain tumours in the CERENAT case-control study." *Occupational Environmental Medicine,* vol. 71, no. 7, 2014, pp. 514-22.

[11] Momoli, F., et al. "Probabilistic multiple-bias modelling applied to the Canadian data from the INTERPHONE study of mobile phone use and risk of glioma, meningioma, acoustic neuroma, and parotid gland tumors." *American Journal of Epidemiology*, 2017.

[12] Turner, Michelle C., et al. "Investigation of bias related to differences between case and control interview dates in five INTERPHONE countries." *Annals of Epidemiology,* vol. 26, 12, 2016, pp. 827-32.

More recently, research carried out by physicists in Israel and others have shown that the higher millimeter wave frequencies to be used in 5G applications uniquely interacts with sweat ducts of the human skin which can then function as antennas to amplify signals. This work extends studies first produced in 1986.[14] The potential long-term impact of such stimulation on precancerous skin growths should be evaluated carefully, including potential super-growth of bacteria.[15] A lecture by Paul Ben-Ishai, PhD, and published research on this issue can be found on the 2017 Conference website.[16, 17, 18]

Cancer is not the only health concern presented by wireless devices and infrastructure. Impacts on reproduction and brain development have also been repeatedly reported in the peer reviewed literature in addition to a myriad of other adverse effects.[19, 20, 21, 22]

In light of these developments showing growing evidence of the biological impact of RF, it is imperative that new infrastructure and 5G not be introduced widely into commerce at this time. The State of California needs to critically consider the potential impact of massive new and possibly carcinogenic wireless exposures to their population. Before introducing additional untested wireless technology into the environment, it is necessary to:

- model exposures to infants, children and pregnant women;
- conduct experimental tests on exposures' impacts on wildlife; and
- evaluate impacts on human systems through in vitro and in vivo toxicology

In 2015, the International EMF Scientist Appeal, now signed by over 225 scientists from 41 nations, was submitted to the Secretary-General of the United Nations, the Director-General of the World Health Organization and U.N. Member Nations urging the development of more protective guidelines for EMF (including RF-EMF), encouraging precautionary measures, and calling for education of the public about

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[13] Grell, Kathrine, et al. "The intracranial distribution of gliomas in relation to exposure from mobile phones: analyses from the INTERPHONE study." *American Journal of Epidemiology*, vol. 184, no. 11, 2016, pp. 818-28.
[14] Gandhi OP, Riazi A. "Absorption of millimeter waves by human beings and its biological implications." *IEEE Transactions on Microwave Theory and Techniques*, vol. 34, no. 2, 1986, pp. 228-235.
[15] Soghomonyan D, K. Trchounian and A. Trchounian. "Millimeter waves or extremely high frequency electromagnetic fields in the environment: what are their effects on bacteria?" Applied Microbiology and Biotechnology, vol. 100, no. 11, 2016, pp. 4761-71.
[16] Feldman, Yuri and Paul Ben-Ishai. "Potential Risks to Human Health Originating from Future Sub-MM Communication Systems." *Conference on Wireless and Health*, 2017.
[17] Hayut, Itai, Paul Ben Ishai, Aharon J. Agranat and Yuri Feldman. "Circular polarization induced by the three-dimensional chiral structure of human sweat ducts." *Physical Review E*, vol. 89, no. 042715, 2014.
[18] Feldman, Yuri, et al. "Human Skin as Arrays of Helical Antennas in the Millimeter and Submillimeter Wave Range." *Physical Review Letters*, vol. 100, no. 128102, 2008.
[19] Adams, Jessica A., et al. "Effect of mobile telephones on sperm quality: a systematic review and meta-analysis." *Environment International,* 70, 2014, pp. 106-112.
[20] Deshmukh, P.S., et al. "Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation." *International Journal of Toxicology*, vol. 34, no. 3, 2015, pp. 284-90.
[21] Aldad, T.S., et al. "Fetal Radiofrequency Radiation Exposure From 800-1900 MHz-Rated Cellular Telephones Affects Neurodevelopment and Behavior in Mice." *Scientific Reports,* vol. 2, no. 312, 2012.
[22] Sonmez, O.F., et al. "Purkinje cell number decreases in the adult female rat cerebellum following exposure to 900 MHz electromagnetic field." *Brain Research,* vol. 1356, 2010, pp. 95-101.

health risks, particularly risks to children and fetal development.[23] Most recently, the EMF Scientists have submitted Comments to the FCC asking the FCC to critically consider the potential impact of the 5th generation wireless infrastructure on the health and safety of the U.S. population before proceeding to deploy this infrastructure.

California firefighters have lobbied to protect themselves and successfully received exemption on health grounds from the installation of these cell towers. Similarly cities and counties should be given the needed local controls to protect their citizens from the health and safety risks of these installations. As currently envisioned, transmitters can be placed in close proximity to bedrooms and schools without consideration of the health of their occupants. Research is critically needed to evaluate the public health and environmental impacts of proposed wireless facilities before deployment.

Worldwide, governments are acting to minimize exposures to children as they are most vulnerable. For example, the Supreme Court of India upheld the High Court of the State of Rajasthan's decision to remove all cell towers from the vicinity of schools, hospitals and playgrounds because of radiation "hazardous to life." In Chile, the 2012 "Antennae Law" prohibits cell antennae/towers in "sensitive areas".[24] Please learn more about international policy actions such as these in our online briefing.[25]

The assumption that all wireless technology is safe has been shown through recent studies to be incorrect. EHT strongly opposes the widespread installation of 5G antennas and towers and believes that the state should move forward on its commitment to support the installation of fiber optic cables buried in the ground to every business, home, school, and hospital in California. We urge the state not to ignore this evidence of harm from RF. Please vote "no" vote on SB 649 and uphold the rights of local government to protect public health and the environment.

Sincerely,

Devra Davis, PhD, MPH
Fellow, American College of Epidemiology
Visiting Prof. Hebrew Univ. Hadassah Medical Center & Ondokuz Mayis Univ. Medical School
Associate Editor, *Frontiers in Radiation and Health*
President, Environmental Health Trust

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[23] Blank, M., et al. "International Appeal: Scientists call for protection from non-ionizing electromagnetic field exposure." *European Journal of Oncology,* vol. 20, no. 3/4, 2015, pp. 180-2.

[24] "New communications antenna law in Chile." *Communications Law: Newsletter of the International Bar Association Legal Practice Division*, vol. 20, no. 1, 2013, pp. 14-16.

[25] "International Policy Briefing: Cautionary Policy on Radiofrequency Radiation Actions by Governments, Health Authorities and Schools Worldwide." Environmental Health Trust, 2017.

July 26, 2017

The Honorable Ben Hueso
Member of the California State Senate
Room 4035, State Capitol
Sacramento, CA 95814

RE: SB 649 (Hueso) – Small Cell Wireless Facilities - OPPOSE

Dear Senator Hueso:

Environmental Working Group (EWG) respectfully opposes your SB 649, which would make the installation of small cell wireless facilities, such as those used to facilitate 5G networks, ministerial rather than discretionary at the local government level.

The health impacts of cellular transmissions have been debated for over ten years because there are studies that raise real concerns about the effects of radio frequency radiation on humans. This is why EWG sponsored two bills by former Senator Leno, SB 1212 (2010) and SB 932 (2011) that would have required sellers of cell phones to inform consumers to minimize exposure to cell phone radiation by reading the manual that comes with the phone, as this is in fact recommended by cell phone manufacturers in their included manuals.

Studies on the health impacts of cell phones and their transmission infrastructure are continuing, but there is already adequate existing sound science for government to proceed with caution on the roll-out of the new technology. In particular, the results of the $25 million National Toxicology Program study (2016) that showed tumors in rats caused by a typical amount of heavy cell phone use are to be reckoned with. And, most of the past science has analyzed older cellular technology like 2G and 4G, so we are moving into uncharted waters with 5G with its different wavelengths and energy levels.

Local governments must be able to evaluate science and respond to the wishes of their citizens and neighborhoods before permits are issued for this technology and SB 649 short-circuits that process. This includes important decisions about locating the technology near homes, schools, and hospitals. We simply cannot rely upon the word of the FCC (in terms of safety standards) to protect the health of Californians.

For these reasons, EWG will be urging a "no" vote for the Assembly floor. We will be writing a separate letter to the Assembly Appropriations Committee on fiscal concerns.

Sincerely,

Bill Allayaud

Bill Allayaud
California Director of Government Affairs
Environmental Working Group

Martin Pall, PhD

August 7, 2017

Dear California Legislators,

I am Dr. Martin Pall, Professor Emeritus of Biochemistry and Basic Medical Sciences at Washington State University. I am a published and widely cited scientist on the biological effects of electromagnetic fields and speak internationally on this topic. I am particularly expert in how wireless radiation impacts the electrical systems in our bodies. I have published 7 studies showing there exists exquisite sensitivity to electromagnetic fields (EMFs) in the voltage sensor in each cell, such that the force impacting our cells at the voltage sensor has massive impact on the biology on the cells of our bodies [1-7]. These papers are discussed in over 360,000 web sites which can be easily found by Googling (Martin Pall electromagnetic). I received my PhD at Caltech, one of the top scientific institutions in the world.

EMFs act by activating channels in the membrane that surrounds each of our cells, called voltage-gated calcium channels (VGCCs). The EMFs put forces on the voltage sensor that controls the VGCCs of about 7.2 million times greater than the forces on other charged groups in our cells [4,6,7]. This is why weak EMFs have such large biological effects on the cells of our bodies! EMFs works this way not only on human and diverse animal cells [1-7] but also in plant cells [7] so that this is a universal or near universal mechanism of action.

Thousands of published studies show biological and health effects from electromagnetic fields. We now know the mechanism that can explain these effects. The mechanism is a function of the electromagnetics of each cell—not solely about heating effects from the radiation (on which present FCC guidelines are based).

This new understanding [1-7] means we can debunk the claims of the wireless industry that there cannot be a mechanism for effects produced by these weak EMFs. The 20 years plus of industry propaganda claims are false. Rather the thousands of studies showing diverse health impacts of these EMFs can be explained. We now have a mechanism, one that is supported by both the biology and the physics, both of which are pointing in exactly the same direction. I am sending as a separate document a list of 134 reviews, each of which provides from 12 to over a thousand individual citations showing health impacts of low intensity EMFs, EMFs that the telecommunications industry claims cannot have such effects. **These 134 reviews and thousands of primary scientific papers they cite show that the industry propaganda has no scientific support whatsoever.**

The consensus among independent scientists on this is further confirmed by the 2015 (and later) appeal made to the United Nations and member states, stating that the current EMF safety guidelines are inadequate because they do not take into consideration non-thermal effects. This was signed by 225 scientists from 41 countries, each of whom had

published peer reviewed studies on EMF health effects – a total of 2,000 papers published in this area by the signers, a substantial fraction of the total publications in this area.

According to industry, the forces electromagnetic fields place on electrically-charged groups in the cell are too weak to produce biological effects. However, the unique structural properties of the voltage-gated calcium channel (VGCC) protein can, it turns out, explain why the force on a cell's voltage sensor from low-intensity EMFs are millions of times stronger than are the forces on singly-charged groups elsewhere in the cell.

It would be a disaster for the health of Californians to be exposed to the antennas envisioned in SB.649. The State of California would be making a grave mistake to proceed with supporting the commercial interests of the wireless industry with this legislation. **Legislators would best pause to understand the gravity of the biological effects, and the ramifications for physical and mental health, as well as consequences from continual damage to human DNA, and learn the facts from scientists who are independent of the wireless industry, not from the industry lobbyists who have a gigantic conflict of interest.**

VGCC activation in cells produced by low intensity EMFs can explain long-reported findings that electromagnetic fields and a wide range of biological changes and health effects. The first 6 of these (see below) were well documented 46 years ago in the U.S. Office of Naval Medical Research report, published in 1971 [8]. The others that follow have been extensively documented subsequently in the peer-reviewed scientific literature:
1) Various neurological/neuropsychiatric effects, including changes in brain structure and function, changes in various types of psychological responses and changes in behavior.
2) At least eight different endocrine (hormonal) effects.
3) Cardiac effects influencing the electrical control of the heart, including changes in ECGs, producing arrhythmias, changes that can be life threatening.
4) Chromosome breaks and other changes in chromosome structure.
5) Histological changes in the testes.
6) Cell death (what is now called apoptosis, a process important in neurodegenerative diseases).
7) Lowered male fertility including lowered sperm quality and function and also lowered female fertility (less studied).
8) Oxidative stress.
9) Changes in calcium fluxes and calcium signaling.
10) Cellular DNA damage including single strand breaks and double strand breaks in cellular DNA and also 8-OHdG in cellular DNA.
11) Cancer which is likely to involve these DNA changes but also increased rates of tumor promotion-like events.
12) Therapeutic effects including stimulation of bone growth.
13) Cataract formation (previously thought to be thermal, now known not to be).
14) Breakdown of the blood-brain barrier.
15) Melatonin depletion and sleep disruption.

They may be low intensity but with regard to the VGCCs, electromagnetic fields can have a tremendously powerful impact on the cells of our bodies. Furthermore, published studies showing that calcium channel blocker drugs block or greatly lower biological effects from electromagnetic fields confirm there is a VGCC activation mechanism that is causing various effects. Higher frequency electromagnetic fields from 5G technologies on the horizon pose even greater biological concern than those to which we are exposed today. We should be moving, instead, to wired technologies at every opportunity, based on what we know in science today, not expanding and supporting the proliferation of wireless.

I want to make several additional points very clear:

1. The Physics and the Biology are both pointing in the same direction. Both show that EMFs act primarily via activating the VGCCs in the cells of our bodies.
2. DNA damage known to be produced by these EMFs occur in human sperm and may also occur in human eggs, leading to large increases in mutation in any children born. It is thought that an increase in mutation frequency of 2.5 to 3-fold will lead to extinction because of accumulation of large numbers of damaging mutations. We may already be over this level, and if so, simply continuing our current exposures will lead to eventual extinction. Further increases in exposures will be more rapidly self-destructive.
3. Pulsed EMFs are, in most cases, more biologically active and therefore more dangerous than are non-pulsed (continuous wave) EMFs. All cordless communication devices communicate via pulsations, because it is the pulsations that carry the information communicated. All the industry claims of safety are based on a theory (only thermal effects) that was known to be wrong back in 1971 [8] – and that was before many thousands of additional studies were published providing massive confirmation that industry claims are false.
4. The industry is trying to move to much higher frequencies because these much higher frequencies allow much higher pulsations and therefore much higher transmission of information. However, these higher pulsation rates make these ultra-high devices vastly more dangerous. This is part of the reasons why it is so important to vote down SB.649.
5. None of our wireless communication devices are ever tested biologically for safety – not cell phone towers, not cell phones, not Wi-Fi, not cordless phones, not smart meters and certainly not 5G phones, or radar units in cars – before they are put out to irradiate an unsuspecting public.
6. The telecommunications industry has corrupted the agencies that are supposed to be regulating them. The best example of this is that the FCC which regulates EMFs in the U.S. is a "captured agency", captured by the industry it is supposed to regulate, according to an 8 chapter document published by the Edmond J. Safra Center for Ethics at Harvard University [9]. Is it any wonder, therefore, that the industry keeps touting that their devices are within the safety guidelines set by the FCC?

I urge you to do the right thing on behalf of the health of Californians and future generations. Please let me know if I can provide further information. (503) 232-3883.

Sincerely,
Martin Pall, PhD (Caltech, 1968)
Professor Emeritus of Biochemistry and Basic Medical Sciences
Washington State University

Citations:

1. Pall ML. 2013 Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. J Cell Mol Med 17:958-965.
2. Pall ML. 2014 Electromagnetic field activation of voltage-gated calcium channels: role in therapeutic effects. Electromagn Biol Med. 2014 Apr 8.
3. Pall ML. 2015 Scientific evidence contradicts findings and assumptions of Canadian Safety Panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts at non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action. Rev Environ Health 30:99-116.
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7. Pall ML. 2016 Electromagnetic fields act similarly in plants as in animals: Probable activation of calcium channels via their voltage sensor. Curr Chem Biol 10: 74-82.
8. Naval Medical Research Institute Research Report, June 1971. Bibliography of Reported Biological Phenomena ("Effects") and Clinical Manifestations, Revised, ZR Glaser.
9. Captured Agency: How the Federal Communications Commission Is Dominated by the Industries It Presumably Regulates, by Norm Alster. Published by Edmond J. Safra Center for Ethics, Harvard University. An e-book under the Creative Commons 4.0 License: https:/creativecommons.org/licences/by/4.0/

June 27, 2017

Assembly Member Cecilia M. Aguiar-Curry
Local Government Committee Chair
State Capitol
P.O. Box 942849
Sacramento, CA 94249-0004
Via email

Re: SB 649 - OPPOSE

Dear Chair Aguiar-Curry,

On behalf of The Greenlining Institute, I am writing to express our opposition to SB 649. SB 649 will not close the digital divide. Instead, it will allow phone and broadband providers to override community decisions about how those communities use public space. Additionally, SB 649 will allow providers to use community-owned property without paying just compensation.

Local Communities Fully Understand the Need for Advanced Phone and Broadband Services.

Every community in California is eager to see faster, more reliable, and more affordable phone and broadband service. Local governments are very aware that advanced telephone and broadband services are critical for access to educational, employment, and economic opportunities. Access to these opportunities is particularly critical for communities of color, who, as a result of the racial wealth and income divides, are more likely to live in areas that lack access to advanced phone and broadband services. State and local governments are particularly well-positioned to ensure that providers are serving communities equitably and non-discriminatorily and that community members have equitable access to economic opportunity.

SB 649 Would Not Help Close The Digital Divide.

Sadly, communications providers have repeatedly demonstrated that they will not make advanced services available to low-income or rural areas unless **they are required to do so**. SB 649 contains no such requirement, instead allowing providers to pick and choose where to build their networks without any community input. Under SB 649, it is likely that providers will focus any service improvements on high-income areas. SB 649 in no way guarantees that low-income communities and communities of color will gain increased access to advanced communications services. Accordingly, SB 649 will not help close the digital divide.

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Unit 6 Eagles Rest
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The Honorable Jerry Brown
Governor, State of California
c/o State Capitol, Suite 1173
Sacramento, CA 95814
September 17, 2017

RE: SB 649 (Hueso) – Small Cell Wireless Facilities — OPPOSE

Honorable Governor Brown,

As a nonprofit research and policy organization dedicated to identifying and reducing environmental health hazards, Environmental Health Trust (EHT) writes to advise you of serious scientific grounds to veto SB 649 as advanced by Senator Hueso. I have personally served as an expert advisor to the California Department of Public Health as well as the city of San Francisco and Berkeley governments on matters relevant to this bill.

You are globally recognized as a champion of the environment and public health. I remain deeply grateful to you for your forward thinking on climate change and toxics policies which provide moral and political leadership at a time when it is sorely lacking. As someone who has been a presidential appointee confirmed by the US Senate, I fully understand the challenges that you face politically. You have provided leadership on the right side of history in too many ways to enumerate.

EHT has a longstanding history of research and policy advice to state, local and national governments regarding strategies to reduce disease and promote health by avoiding environmental health hazards. Our organization opposes the broad scale installation of untested wireless antennas and associated electrical equipment close to humans and through critical wildlife habitat and corridors.

The assumption that all wireless technology is safe has been shown through recent studies to be incorrect. EHT strongly opposes the widespread installation of 5G antennas and towers and believes that the state should move forward on its commitment to support the installation of fiber optic cables buried in the ground to every business, home, school, and hospital in California. We urge the state not to ignore this evidence of harm from wireless technologies.

Specific design standards must first be funded and created for 5G facilities for the more than thirty thousand expected new radiating 5G cell antennas to be constructed on city and county utility light poles and in the right of ways in close proximity to city and county workers, children, residents and visitors. Both federal and local zoning controls are absolutely needed to assure that cellular equipment are installed to avoid significant and serious safety threats of electrical shock, fire, and radio frequency (RF) microwave radiation exposures, as well as chronic impacts on public health and the environment.

Now the challenge before you is one of the most momentous you will have ever faced. The telecom industry is a global multi-trillion dollar phenomenon. They have provided massive amounts of political support throughout the political spectrum. Despite this, the weight of science has inexorably demonstrated that the experiment they

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have been conducting on ourselves and our progeny is without merit and has already exacted a serious toll for public health.

SB 649 will pave the way for widespread introduction of 5G microwave wireless radiation frequency (RF) that has never been tested for its impact of public health or the environment. Other RF microwave radiation such as that used by cellphones and other wireless devices has been classified as a 'possible carcinogen' by the International Agency for Research on Cancer in 2011 and more recently dubbed a 'probable carcinogen,' by expert researchers looking at newer information in 2015.[1,2,3] In addition, this bill could result in the loss of hundreds of millions of dollars in local revenue, as the San Francisco Chronicle noted today.

By ignoring growing scientific evidence of harm, the bill effectively will ensure the widespread exposures of millions of Californians to an agent that growing numbers of scientists and nations consider a serious health threat. Recently, studies have found that the frequencies which will be used in 5G and other future technologies can have harmful effects[4], as Dr. Cindy Russell, Vice President of Community Health for the Santa Clara Medical Association noted.[5] As articulated in their state Constitution, California cities and counties have a duty to protect the health and safety of their residents.

State and local authority and duty should not be overridden by any preemptive policies such as SB 649 which disregards scientific evidence on this matter as outlined below. Regarding potential health risks from RF a number of corporations advise their shareholders that they face serious risks from RF. For instance, Crown Castle's 2016 10-K ANNUAL REPORT, states that,

> *"If radio frequency emissions from wireless handsets or equipment on our wireless infrastructure are demonstrated to cause negative health effects, potential future claims could adversely affect our operations, costs or revenues. The potential connection between radio frequency emissions and certain negative health effects, including some forms of cancer, has been the subject of substantial study by the scientific community in recent years. We cannot guarantee that claims relating to radio frequency emissions will not arise in the future or that the results of such studies will not be adverse to us...If a connection between radio frequency emissions and possible negative health effects were established, our operations, costs, or revenues may be materially and adversely affected. We currently do not maintain any significant insurance with respect to these matters."*

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[1] World Health Organization. "IARC classifies radiofrequency electromagnetic fields as possibly carcinogenic to humans," WHO, Press Release, no. 208, 2011.
[2] IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. "Non-ionizing radiation, Part 2: Radiofrequency electromagnetic fields." *IARC Monographs On The Evaluation of Carcinogenic Risks to Humans*, vol. 102, pt. 2, 2013.
[3] Morgan, L. Lloyd, et al. "Mobile phone radiation causes brain tumors and should be classified as a probable human carcinogen (2A)." *International Journal of Oncology,* vol. 46, no. 5, 2015, 1865-71.
[4] Feldman, Yuri, et al. "Human Skin as Arrays of Helical Antennas in the Millimeter and Submillimeter Wave Range." *Physical Review Letters*, vol. 100, no. 128102, 2008.
[5] Russell, Cindy. "A 5G Wireless Future: Will it give us a Smart Nation or Contribute to an Unhealthy One?" Santa Clara Bulletin, Jan./Feb. 2017.

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Most wireless companies from AT&T to Nokia to T Mobile to Verizon Wireless have issued similar warnings to their shareholders.

Regarding public health impacts, recently released research findings from the premiere test program of the National Institute of Environmental Health Sciences (NIEHS) add to the body of scientific evidence indicating that RF microwave radiation can be harmful. The 10 year $25 million NIEHS National Toxicology Program's Studies of the Toxicology and Carcinogenicity Cell Phone Radiation reports that RF produced increases rates of highly malignant very rare tumors: gliomas of the brain and schwannomas of the heart.[6] These experimental findings are consistent with human studies showing increased rates of gliomas and acoustic neuromas (schwann cells) among humans exposed to cell phone radiation. In addition to increased cancers, the NTP study also reported that prenatally exposed animals produced offspring with lower birth weight and evidence of direct genetic damage.

Since the 2011 WHO/IARC classification, the peer reviewed research connecting microwave exposure to cancer has significantly strengthened. In 2015, a study replicated a 2010 experiment that found that weak cell phone signals significantly promote the growth of tumors in mice, and that toxic chemical exposures combine with RF to more than double the tumor response.[7,8] The Ramazzini Institute is engaged in similar research with RF that is 1000 less than the NTP exposures—set to mimic radiation exposure levels caused by network equipment (e.g., cell tower antenna emissions).

Consistent with the NTP findings, the Ramazzini Institute team report significantly lower litter weights, as presented at the January 2017 Conference on Wireless and Health at Israel Institute for Advanced Study, Hebrew University of Jerusalem.[9] Findings of effects at such low levels is indication of the capability of low level electromagnetic radiation exposure to result in biological effects.

Other studies finding serious increased risk of glioma in regular cell phone users are of special relevance. In 2014, a French national study linked higher cell phone exposure to increased glioma in cell phone users.[10] A newly published research report in the *American Journal of Epidemiology* finds that Canadians who have used cell phones for 558 hours or more have more than a doubled risk of brain cancer.[11] Previous published re-analysis of the multi country Interphone study data has found stronger positive associations to glioma risk

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[6] Wyde, Michael, et al. "Report of Partial findings from the National Toxicology Program Carcinogenesis Studies of Cell Phone Radiofrequency Radiation in Hsd: Sprague Dawley® SD rats (Whole Body Exposure)." *bioRxiv,* no. 055699, 2016.
[7] Lerchl, Alexander, et al. "Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans." *Biochemical and Biophysical Research Communications,* vol. 459, no. 4, 2015, pp. 585-90.
[8] Tillmann, Thomas, et al. "Indication of cocarcinogenic potential of chronic UMTS-modulated radiofrequency exposure in an ethylnitrosourea mouse model." *International Journal of Radiation Biology,* vol. 86, no. 7, 2010, pp. 529-41.
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[10] Coureau, Gaëlle, et al. "Mobile phone use and brain tumours in the CERENAT case-control study." *Occupational Environmental Medicine,* vol. 71, no. 7, 2014, pp. 514-22.
[11] Momoli, F., et al. "Probabilistic multiple-bias modelling applied to the Canadian data from the INTERPHONE study of mobile phone use and risk of glioma, meningioma, acoustic neuroma, and parotid gland tumors." *American Journal of Epidemiology*, 2017.

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among long term users and heavy users and a statistically significant association between where tumors were located and how much radiation an individual received from their phone.[12,13] A 2017 review published by Hardell and Carlberg concludes that "RF radiation should be regarded as a human carcinogen causing glioma."[14] I invite you to view videos from Environmental Health Trust's expert forum in Jackson Hole, Wyoming on July 30, 2017 where longtime World Health Organization advisor Dr. Anthony Miller presented the scientific evidence for his updated opinion that RF is a human carcinogen.

More recently, research carried out by physicists in Israel and others have shown that the higher millimeter wave frequencies to be used in 5G applications uniquely interacts with sweat ducts of the human skin which can then function as antennas to amplify signals.[15] This work extends studies first produced in 1986.[16] The potential long-term impact of such stimulation on precancerous skin growths should be evaluated carefully, including potential super-growth of bacteria.[17] A lecture by Paul Ben-Ishai, PhD, and published research on this issue can be found on the 2017 Conference website.[18,19,20]

Cancer is not the only health concern presented by wireless devices and infrastructure. Impacts on reproduction and brain development have also been repeatedly reported in the peer reviewed literature in addition to a myriad of other adverse effects.[21, 22, 23, 24]

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[13] Grell, Kathrine, et al. "The intracranial distribution of gliomas in relation to exposure from mobile phones: analyses from the INTERPHONE study." *American Journal of Epidemiology*, vol. 184, no. 11, 2016, pp. 818-28.

[14] Carlberg, Michael, and Lennart Hardell. "Evaluation of Mobile Phone and Cordless Phone Use and Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation." *BioMed Research International* 2017.9218486 (2017).

[15] Betzalel, Noa, Yuri Feldman, and Paul Ben Ishai. "The Modeling of the Absorbance of Sub-THz Radiation by Human Skin." *IEEE Transactions on Terahertz Science and Technology* 7.5 (2017): 521-8.

[16] Gandhi OP, Riazi A. "Absorption of millimeter waves by human beings and its biological implications." *IEEE Transactions on Microwave Theory and Techniques*, vol. 34, no. 2, 1986, pp. 228-235.

[17] Soghomonyan D, K. Trchounian and A. Trchounian. "Millimeter waves or extremely high frequency electromagnetic fields in the environment: what are their effects on bacteria?" *Applied Microbiology and Biotechnology*, vol. 100, no. 11, 2016, pp. 4761-71.

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[20] Feldman, Yuri, et al. "Human Skin as Arrays of Helical Antennas in the Millimeter and Submillimeter Wave Range." *Physical Review Letters*, vol. 100, no. 128102, 2008.

[21] Adams, Jessica A., et al. "Effect of mobile telephones on sperm quality: a systematic review and meta-analysis." *Environment International,* 70, 2014, pp. 106-112.

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[24] Sonmez, O.F., et al. "Purkinje cell number decreases in the adult female rat cerebellum following exposure to 900 MHz electromagnetic field." *Brain Research,* vol. 1356, 2010, pp. 95-101.

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In light of these developments showing growing evidence of the biological impact of RF, it is imperative that new infrastructure and 5G not be introduced widely into commerce at this time. The State of California needs to critically consider the potential impact of massive new and possibly carcinogenic wireless exposures to their population. Before introducing additional untested wireless technology into the environment, it is necessary to:

- model exposures to infants, children and pregnant women;
- conduct experimental tests on exposures' impacts on wildlife; and
- evaluate impacts on human systems through in vitro and in vivo toxicology

In 2015, the International EMF Scientist Appeal, now signed by over 225 scientists from 41 nations, was submitted to the Secretary-General of the United Nations, the Director-General of the World Health Organization and U.N. Member Nations urging the development of more protective guidelines for EMF (including RF-EMF), encouraging precautionary measures, and calling for education of the public about health risks, particularly risks to children and fetal development.[23] The EMF Scientists later submitted Comments to the FCC asking the FCC to critically consider the health impact of the 5G.

Most recently, in September 2017, over 180 scientists and doctors from 35 countries sent a declaration to the European Union calling for a moratorium on 5G expansion citing potential neurological impacts, infertility, and cancer.[25]

California firefighters have lobbied to protect themselves and successfully received exemption on health grounds from the installation of these cell towers.[26] Similarly cities and counties should be given the needed local controls to protect their citizens from the health and safety risks of these installations. As currently envisioned, transmitters can be placed in close proximity to bedrooms and schools without consideration of the health of their occupants. Research is critically needed to evaluate the public health and environmental impacts of proposed wireless facilities before deployment.

The organization that I founded a decade ago, Environmental Health Trust, is not opposing cell phones. We are in favor of public health and we note that the California Department of Public Health has drafted guidelines for safer use of phones so that the public reduce radiofrequency exposure for more than a decade.

As my colleagues who have been supported by the US Department of Defense on 5G have written to you, the evidence is compelling that this technology can interact with human body in ways that have never been evaluated for their long-term impact on health and safety. Recently, studies have found that the frequencies which will be used in 5G and other future technologies can have harmful effects[27], as Dr. Cindy Russell, Vice

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[25] "Appeal to the European Union: Scientists warn of potential serious health effects of 5G." 13 September 2017.
[26] ""The Firefighters Wake Up Call To Us All" By Susan Foster RE: SB 649 Opposing Cell Towers In Rights Of Way." *Environmental Health Trust* (2017).

[27] Feldman, Yuri, et al. "Human Skin as Arrays of Helical Antennas in the Millimeter and Submillimeter Wave Range." *Physical Review Letters*, vol. 100, no. 128102, 2008.

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President of Community Health for the Santa Clara Medical Association noted.[28] As articulated in their state Constitution, California cities and counties have a duty to protect the health and safety of their residents.

Cardiologists are reporting increased numbers of patients with atrial fibrillation and heart disease who have no inherited risk factors. A recent study by Professor Gemma Figtree, published in the European Journal of Preventive Cardiology, found that the rate of heart attacks and heart disease in persons with no known risk factors has more than doubled in less than a decade.[29] Similar rates of serious eye problems and attention deficit disorder continue to increase without any knowns. Certainly, the phenomenal growth in the use of wireless technology should be explored as one of the explanations for these serious public health.

Please veto SB 649 and uphold the rights of local government to protect public health and the environment.

Sincerely,

Devra Davis, PhD, MPH
Founder & President, Environmental Health Trust
Fellow, American College of Epidemiology
Visiting Professor of Medicine, Hebrew University of Jerusalem and Ondokuz Mayis University

CC
Tom Dyer, Chief Deputy Legislative Affairs Secretary

Letter from Dr. Paul Ben Ishai to Governor Brown
Order Instituting Rulemaking to update the Commission's policies and procedures related to Rulemaking 04-08-020 electromagnetic fields emanating from regulated (Filed August 19, 2004) utility facilities.

[28] Russell, Cindy. "A 5G Wireless Future: Will it give us a Smart Nation or Contribute to an Unhealthy One?" Santa Clara Bulletin, Jan./Feb. 2017.
[29] Vernon, Stephen T., et al. "Increasing proportion of ST elevation myocardial infarction patients with coronary atherosclerosis poorly explained by standard modifiable risk factors." *European Journal of Preventive Cardiology* (2017). doi: 10.1177/2047487317720287.

EM-RADIATION
RESEARCH TRUST

June 22, 2017

Assembly Member Cecilia M. Aguiar-Curry
Chair of the Local Government Committee
1020 N Street, Room 157
Sacramento, California 95814

RE: SB 649

Dear Assembly Member Aguiar-Curry:

I am writing in opposition to SB 649 which will deny the public's right to participate in local decisions. The public has a constitutional right to protect our homes, our privacy, our health and the health of our children from RF radiation which soon will be in the form of 5G millimeter waves.

5G, the technology for which these small cells are a foundational part of the infrastructure, has not been tested on humans. On June 20, 2016 then-outgoing FCC Chairman Tom Wheeler announced at the Washington Press Club that 5G "redefines network connectivity for years to come." When asked by a Bloomberg reporter about health concerns, Chairman Wheeler replied the FCC did not have time to study health because the infrastructure for 5G will "generate tens of billions of dollars in economic activity." In short, 5G is a moneymaker. That concept is driving this bill and it is simply wrong. Not only is it wrong, but it is dangerous, and we need to listen to the firefighters before approving a bill from which there is no viable return.

SB 649 states: "the impact on local interests from individual small wireless facilities will be sufficiently minor." I disagree. The Bill was written by the industry, for the industry. It fails the consumer. It particularly fails the unborn, children, those with immune suppression, the infirm, the disabled, and the elderly. This technology has the capacity to completely disable sensitive segments of the population. It has the ability to inhibit repair of DNA, an essential component to our survival. An increasing number of studies show it has the ability to break DNA outright.

From a neurological and immunological perspective, RF (wireless) radiation has the power to interfere with how we think, how we behave, how we feel. It affects the Central Nervous System (the brain), and it affects our immune system. Those two systems overlap more than any other bodily systems, and thus if one is adversely affected, the other may be, as well. Many people are rendered EHS or "electro-hypersensitive" after continuous exposure to WiFi, cell towers, or cell phone exposure. This is particularly true if the exposure is 24/7, which small cells would be.

Over 15 years ago California did a survey and determined as many as 7% of its population was EHS or electro-hypersensitive, e.g. they have adverse reactions sometimes hours after exposure to wireless such as headache, cognitive impairment, inability to sleep, inability to stay awake, tinnitus, depression, or inability to focus. Conservative estimates in Europe and the US put the number at 3% with respect to EHS in a given population. Some studies show 11% as a more current reflection of EHS. In 2015 the US Census Bureau put the population of California at 39.14 million. Assuming the more conservative 3%, that translates to over 11.7 million Californians who must seek relief from wireless exposure for medical reasons.

Because 5G (for which SB 649 was requested by industry) is designed to penetrate walls with a focused, amplified beam there will be no safe haven, thus leaving California without a low cost prudent avoidance policy for those who are disabled from EMF exposure. Many of these small cells will be directly outside the homes and work places of individuals who are EHS.

Furthermore, there is virtually no oversight with respect to our existing RF exposure to 2G, 3G and 4G, and none is written into the bill to monitor or in any way assess the health impact of 5G. This bill will instantly make life more difficult for the 11 million-plus people who are EHS to find refuge from wireless. In fact, it will make it virtually impossible because 5G on small cell antenna can penetrate any wall, any barrier. That is what 5G is designed to do. This will be in direct violation of the Americans with Disabilities Act.

Additionally, health care costs for California will rise with this massive build out of infrastructure resulting in an exponential increase in radiation exposure not just at work and at school, but at home.

This bill is being rushed to passage, and there is a failure on the part of the bill's sponsors to take the potential health impact into consideration. It is up to you all as legislators to pause and consider the implications of what you are doing. Somehow people have come to believe wireless is like oxygen. We need it to survive. The truth is the exact opposite is true. When did anyone ever think microwave radiation was safe? Yes, this <u>is</u> microwave radiation. RF radiation is a euphemism. It is window-dressing. This technology is *not* safe.

I am far from alone in voicing this opinion. Just look at the firefighters. They are very well aware of the dangers as firestations were among the first commercial spaces targeted for cell tower placement, and the firefighters have lived with this exposure 24/7 for years. **The firefighters oppose SB 649 due to health concerns and have been granted an exemption for their stations.** I concur with the exemption for the firefighters.

As an Honorary Firefighters for the San Diego Fire Department, as the organizer of the only SPECT brain scan study of firefighters in California or anywhere in the US and Canada, as the original author of Res. 15 to call for a moratorium on the placement of cell towers throughout the US and Canada (2003), as a US Adviser to the Radiation Research Trust, and as a medical writer I can assure you that the language of your bill suggesting a "minor" impact is dangerously wrong. I am far from alone. 122 cities throughout California officially oppose SB 649. In addition, to date, 12 counties and myriad organizations oppose this bill.

I have worked with firefighters for over 15 years. My focus has been testing and educating firefighters about the neurological effects of RF radiation, yet the carcinogenic effects are deeply disturbing, as well. Brain cancer is now one of the leading cancers among firefighters and is considered a presumptive cancer in many states. Bottom line: Cell towers have made firefighters ill, impaired their ability to work and protect the public, and may have contributed to deaths.

On February 23, 2013 under WT Docket No. 12-357 I filed my comments with the FCC detailing the findings of a 2004 brain study I organized in which Dr. Gunnar Heuser and Dr. J. Michael Uszler of Santa Monica, CA conducted a pilot study of six (6) California firefighters who had been exposed to a cell tower 9' from their station for five years. These men had become ill – some within minutes, some within hours – after activation of the cell tower next to their station *in spite of months of reassurances from the industry that there were no ill effects from the towers*. The men were experiencing profound neurological symptoms.

The symptoms experienced by the firefighters, all of whom had passed rigorous physical and cognitive exams prior to being hired by the fire department, included but were not limited to the following: headaches, extreme fatigue, sleep disruption, anesthesia-like sleep where the men woke up for 911 calls "as if they were drugged", inability to sleep, depression, anxiety, unexplained anger, getting lost on 911 calls in the town they grew up in, a twenty (20) year medic forgetting basic CPR in the midst of resuscitating a coronary victim, and immune-suppression manifest in frequent colds and flu-like symptoms.

All six (6) firefighters were found to have brain abnormalities on SPECT scan [single-photon emission computed tomography]. The doctors thought they would find areas of limited function in the brain based on the symptomatology. Instead, they found a pervasive, hyper-excitability of the neurons which suggested the exposure to RF (microwave) radiation was causing the neurons to continually fire without benefit of rest. RF radiation appeared to act as a constant stimulant even when the men were away from the station and in repose. The SPECT scans were considered abnormal in all six firefighters.

Cognitive function, reaction time, and impulse control were measured objectively using T.O.V.A. testing [Test of Variables of Attention]. In all six (6) firefighters, impairment was found with cognitive function, reaction time and impulse control. Three (3) of the six (6) firefighters were captains. The captain on each shift is in charge of making life altering decisions for all firefighters and potential victims. They order firefighters into a burning building, and conversely, they order them out before a roof may collapse, for example. Impairment of all three critical functions could cost firefighters and the community they serve either life or limb.

The testing was conducted in 2004. The cell towers were in place at the two (2) fire stations where the test subjects work for the duration of a twenty-two (22) year lease. The men we tested have remained at the stations as this is the only work they know in the only community they have ever lived in. One (1) of the six (6) men tested did move to another department after his wife gave birth to a boy who was diagnosed with Autism at age 2. This was the first live birth experienced by the "firefighter family" at this department since activation of the tower three (3) years earlier.

What is particularly germane to the critical decisions you are currently facing with SB 649 has to do with the industry line that the radiation from these small cells will be well under the safety guidelines set by the FCC. The FCC currently allows 1,000 microwatts per centimeter squared (uW/cm2) as an emission standard from cell towers. Yet all the symptoms attributed by the firefighters, as well as measurable brain and central nervous system abnormalities described above, occurred within close proximity to a cell tower measured at between 1 - 2 uW/cm2 by Peter Sierck, BBEC, CEO of Environmental Testing & Technology in Encinitas, CA. **Thus the emissions from towers were measured at approximately 1/1000th to 1/500th of the FCC's allowable limit.** "Hot spots" of reflected radiation were measured at 15 and 30 uW/cm2, yet these "hot spots" were still a fraction of what the FCC allows. Therefore, I strongly suggest **the FCC is not basing its standards on biological effects, but rather physics, and principles of physics do not protect the brains and central nervous systems of even the strongest among us -- our firefighters**. Please see my FCC filing at https://ecfsapi.fcc.gov/file/7022117660.pdf

You know the gist of this, or you would not have granted an exemption for firefighters from SB 649. In fact, Section 65964.2 specifically states small cells will not be located on a fire department facility. I know the firefighters asked for and received this exemption based on their concerns about adverse health effects from cell towers on or near their stations.

I know this exemption would not have been granted had you not believed that firefighters were at risk. And if firefighters, the strongest of the strong among us, are experiencing symptoms that impair their work performance due to severe headache, disorientation, sleep disturbance, cognitive impairment, delayed reaction time, lack of impulse control and mood swings, that begs the obvious question: What about the rest of us?

I implore you to see this bill for what it is. It is industry's gift to industry carried out by well-intentioned senators and assembly members who think they are doing what is best for their constituents. The "best" is to deny this carte blanche blanketing of small cells without local control.

Listen to the firefighters, and understand these brave men and women speak for all of us. If they are concerned about harm to their health, then we should be as well.

Respectfully Submitted,

Susan Foster

/s/ Susan Foster

Susan Foster *for the* RADIATION RESEARCH TRUST
US Adviser
Honorary Firefighter, San Diego Fire Department
Medical Writer
Rancho Santa Fe, CA 92091
susan.foster04@gmail.com

cc: dixie.petty@asm.ca.gov
nidia.bautista@sen.ca.gov
lilia.stone@asm.ca.gov
lily.movsisyan@asm.ca.gov
cody.storm@asm.ca.gov
nardos.girma@asm.ca.gov
jovan.agee@asm.ca.gov
laurel.brodzinsky@asm.ca.gov
steven.stenzler@asm.ca.gov
enedina.garcia@asm.ca.gov

EMF SAFETY NETWORK
PO Box 1016 Sebastopol CA 95473
707-827-0109

EON The Ecological Options Network
PO Box 1047, Bolinas, CA 94924
415-868-1900

Assembly Member Miguel Santiago
Chair of the Communications and Conveyance Committee
P.O. Box 942849
Sacramento, CA 94249-0053
RE: SB 649 Wireless and Small Cell Telecommunications Facilities (amended 7/3/2017)
Strongly oppose

Dear Assembly Member Miguel Santiago,

EMF Safety Network[1] and Ecological Options Network[2] strongly oppose SB 649 regarding telecommunications facilities. SB 649 eliminates local zoning authority, conflicts with federal and other laws, and increases harmful radio frequency radiation (RFR). International independent scientists are calling for reducing RFR based on peer reviewed published science showing RFR harms the public and nature, and children are especially vulnerable.

SB 649 abandons the public to trust the telecom industry to certify safety and RFR compliance with federal laws.

1) SB 649 eliminates local authority

SB 649 will allow a ministerial permit for antenna siting for the majority of local governments. This over the counter permit will gift multiple companies unlimited access to deploy unlimited antennas in our neighborhoods and countrysides. Local authority is

[1] EMF Safety Network (EMFSN) was founded in 2009. Our mission is to educate and empower people by providing science and solutions to reduce EMFs, achieve public policy change, and obtain environmental justice. We have participated in proceedings at the California Public Utilities Commission since 2010. www.emfsafetynetwork.org

[2] Ecological Options Network(EON) was founded in 2003, is a 501 (c) (3) organization that networks with utility customers and organizations to empower policy protecting health, environment and consumer rights. http://www.eon3.net/

needed to ensure community safety and welfare[3], and compliance with federal laws[4]. SB 649 would overturn a recent California court case where San Francisco won the right to determine antenna placement. The court discussed in detail and ruled Public Utilities Codes 7901 and 7901.1 did not limit a city's right to design review.[5] SB 649 conflicts with California Public Utilities Commission (CPUC) no and low cost EMF avoidance policy[6] adopted in 1993. In 2006 the CPUC upheld the policy, which included RFR.[7]

2). SB 649 conflicts with federal laws

The Federal Telecommunications Act of 1996 preserves local zoning authority, and requires compliance with environmental laws and RFR safety rules. An over the counter permit would conflict with RFR compliance required by federal Law. According to the Federal Communications Commission(FCC) website[8]:

- *"Building a new tower or collocating an antenna on an existing structure requires compliance with the Commission's rules for environmental review. These rules ensure that licensees and registrants take appropriate measures to protect environmental and historic resources, and that the agency meets its obligations under the National Environmental Policy Act (NEPA) to consider the potential environmental impact of its actions, as well as under other environmental statutes such as the National Historic Preservation Act (NHPA) and the Endangered Species Act (ESA)."*
  - "NEPA requires agencies to consider and disclose the environmental effects of its actions to improve decision-making and encourage transparency, public participation,and accountability. Effects are defined broadly to include ecological, aesthetic, historic, social, and cumulative and indirect effects."

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[3] Cal. Const., art. XI, §7 "A county or city may make and enforce within its limits all local, police, sanitary, and other ordinances and regulations not in conflict with general laws."

[4] FCC Tower and Antenna Siting: https://www.fcc.gov/general/tower-and-antenna-siting

[5] T-Mobile West vs City and County of San Francisco (Appeal denied): http://www.gmsr.com/wp-content/uploads/2017/02/scw-A144252M.pdf

[6] CPUC actions regarding EMFs http://www.cpuc.ca.gov/environment/emf/actions.htm

[7] CPUC D.06-01-042.

[8] FCC Tower and Antenna Siting: https://www.fcc.gov/general/tower-and-antenna-siting

- *"Collocations, including Distributed Antenna Systems (DAS) and Small Cells, may also require compliance with these same processes."*
- "Section 332(c)(7) of the Communications Act preserves state and local authority over zoning and land use decisions for personal wireless service facilities, but sets forth specific limitations on that authority." …"The statute also preempts local decisions premised directly or indirectly on the environmental effects of radio frequency (RF) emissions, assuming that the provider is in compliance with the Commission's RF rules."

The fact that these antennas are called "small cell" does not mean they comply with the FCC rules quoted above. The FCC calculates RFR by what the public's exposure levels are, including frequencies, radiated power, and distance.

For example:

- *What frequencies will be used?*
- *What is the radiated power at the source?*
- *How many antennas are in one enclosure?*
- *What is the exposure level at ground level? at 20 feet? at 100 feet?*
- *What is the existing cumulative RFR exposure level at ground level? at 20 feet? at 100 feet?*
- *Is the ground flat or falling? If not, what are the exposure levels at what height and distance?*
- *What is the future colocation RFR exposure?*

SB 649 also conflicts with federal law (Section 6409) which exempts cities from antenna modifications on city property.[9]

3) California Environmental Quality Act (CEQA) laws apply

The deployment of a denser "small cell" antenna system is a major change to the environment, not a minor one, and therefore subject to CEQA laws. There is no substantial evidence to support SB649's determination that the deployment fits the CEQA exemption. There is substantial evidence in support of a fair argument that the

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[9] Best Best and Kreiger FCC's Wireless Facility Rules Implementing Section 6409(a) pdf p.15 2015 http://sananselmo-ca.granicus.com/DocumentViewer.php?file=sananselmo-ca_8397b41675b5de650a27df9d779ecbd7.pdf

project may create environmental impacts. Whenever it can be fairly argued on the basis of substantial evidence that there is a reasonable possibility that a project may have a significant effect on the environment, an exemption is not proper.

4) Telecoms' interests should not outweigh city and county jurisdiction

"Telecoms want customers… Wireless service has become essential… for better quality of life." These claims were part of the supporters testimony at the Local Government Committee hearing on June 28, 2017. Not all Californians want their homes, neighborhoods, towns, and rural country-sides to be polluted with RFR. Telecom deployment serves the unbounded profit motive of telecom corporations. What is in the best public interest is to avoid unnecessary RFR exposures. There is a growing movement of educated Americans who are aware of cancer and other health impacts associated with RFR. In California tens of thousands of utility customers have refused, or opted out of smart meters. Significant percentages of people, those already sickened, and those trying to avoid being injured, adamantly oppose being involuntarily exposed to more radiation for benefit of telecommunications profits. Access to the internet is safer using wired connections. Wireless is not an essential public service.

5) The FCC historically honors local control

On July 14, 2016 FCC Commissioner Jessica Rosenworcel stated during her approval of 5G millimeter wave deployment, ***"By law and tradition we honor local control in this country."***[10] SB 649 should be opposed because it will dishonor and impede local control and deliberately thwart public participation. We support the comments of The League of California Cities who state SB 649, *"unnecessarily and unconstitutionally strips local authority over public property and shuts out public input and local discretion by eliminating consideration of the aesthetic and environmental impacts of "small cells."*

6) SB 649 increases harmful RFR exposure to humans and nature.

International independent scientists are calling for immediate measures to reduce RFR. Peer reviewed, published science shows RFR poses serious health and safety impacts

[10] At 19: 27 https://www.fcc.gov/news-events/events/2016/07/july-2016-open-commission-meeting

to the public and nature. Children are more vulnerable.

- 224 scientists have signed the International EMF Scientist Appeal: *"We are scientists engaged in the study of biological and health effects of non-ionizing electromagnetic fields (EMF). Based upon peer-reviewed, published research, we have serious concerns regarding the ubiquitous and increasing exposure to EMF generated by electric and wireless devices. These include–but are not limited to–radiofrequency radiation (RFR) emitting devices, such as cellular and cordless phones and their base stations, Wi-Fi, broadcast antennas, smart meters, and baby monitors as well as electric devices and infra-structures used in the delivery of electricity that generate extremely-low frequency electromagnetic field (ELF EMF)." "Effects include increased cancer risk, cellular stress, increase in harmful free radicals, genetic damages, structural and functional changes of the reproductive system, learning and memory deficits, neurological disorders, and negative impacts on general well-being in humans."* [11] Scientists quotes:
    - *"Based upon epidemiological studies there is consistent evidence of increased risk for brain tumors (glioma and acoustic neuroma) associated with use of wireless phones." Lennart Hardell, MD, PhD University Hospital, Orebro, Sweden*
    - "The harmful effects of electromagnetic fields, regardless of their frequencies, are now scientifically settled. Pregnant women (the fetus) and children and adolescents are particularly vulnerable."- Dominique Belpomme, MD, MPH, Paris V Descartes University, European Cancer & Environment Research institute.
    - *"Migratory birds -- incredibly important to the global economy and for the ecological services they provide -- now appear to be negatively affected by non-ionizing radiation."* Dr. Albert Manville, Adjunct Professor, Johns Hopkins University; Senior Wildlife Biologist, U.S. Fish & Wildlife Service (FWS), Emeritus/Retired
- The National Toxicology Program published a 25 million dollar study which is one of the largest and most comprehensive studies on cell phone radiation and cancer. In

[11] EMF Scientist appeal https://www.emfscientist.org/index.php/emf-scientist-appeal

the study the rats exposed to cell phone radiation developed two types of cancers, glioma, a brain tumor, and schwannoma, a tumor in the heart. The summary includes,*"Given the widespread global usage of mobile communications among users of all ages, even a very small increase in the incidence of disease resulting from exposure to RFR could have broad implications for public health."*[12]

- The BioInitiative Report updated in 2012, prepared by 29 authors from ten countries, reviewed 1800 studies and conclude,*"EMF and RFR are preventable toxic exposures. We have the knowledge and means to save global populations from multi-generational adverse health consequences by reducing both ELF and RFR exposures. Proactive and immediate measures to reduce unnecessary EMF exposures will lower disease burden and rates of premature death."*[13]
- The International Agency for Research on Cancer at the World Health Organization classifies RFR as a 2B (possible) carcinogen.[14]

7) **Peer reviewed published studies show proximity to antennas is hazardous.**

Neurobehavioral effects among inhabitants around mobile phone base stations *"The prevalence of neuropsychiatric complaints as headache (23.5%), memory changes (28.2%), dizziness (18.8%), tremors (9.4%), depressive symptoms (21.7%), and sleep disturbance (23.5%) were significantly higher among exposed inhabitants than controls…"*[15]

- Epidemiological Evidence for a Health Risk from Mobile Phone Base Stations *"We found that eight of the 10 studies reported increased prevalence of adverse neurobehavioral symptoms or cancer in populations living at distances < 500 meters from base stations."*[16]

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[12] NTP cell phone study http://ntp.niehs.nih.gov/results/areas/cellphones/index.html

[13] Bioinitiative Report http://www.sciencedirect.com/science/journal/09284680/16/2-3

[14] IARC/WHO https://goo.gl/BrkpG8

[15] Neurobehavioral effects among inhabitants around mobile phone base stations https://www.ncbi.nlm.nih.gov/pubmed/16962663

[16] Epidemiological Evidence for a Health Risk from Mobile Phone Base Stations https://goo.gl/Zz6dhk

8) Future cell tower plans are for 5G which emits millimeter waves. Peer reviewed published science shows millimeter waves penetrate the skin and affect human health.[17] Millimeter wave technology has been developed as a crowd control weapon which causes acute burning pain, as if the body is on fire.[18]

- An analysis of studies on millimeter waves (MMWs) "State of knowledge on biological effects at 40–60 GHz"[19] states, *"At the cellular level, it stands out from the literature that skin nerve endings are probably the main targets of MMWs and the possible starting point of numerous biological effects."* Effects reviewed include effects on capillaries and nerve endings, protein insults, epigenetic regulation, and the risk of homeostasis disruption, which would have dramatic consequences.

9) Peer reviewed published studies show RFR exposure harms nature.

- The US Department of the Interior states RFR threatens birds, and they criticize the FCC's radiation safety guidelines stating*,"the electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today."* Two hundred forty one bird species are at mortality risk from both tower collisions and from exposure to the radiation towers emit. This includes birds that are endangered or threatened, Birds of Conservation Concern, migratory birds, and eagles. Studies of radiation impacts on wild birds documented nest abandonment, plumage deterioration and death. Birds studied included House Sparrows, White Storks, Collared Doves, and other species. Studies in laboratories of chick embryos documented heart attacks and death.[20]
- Scientists in Germany studied tree damage in relation to electromagnetic radiation from 2006-2015. They monitored, observed and photographed unusual or unexplainable tree damage, and measured the radiation the trees were exposed too.*"The aim of this study was to verify whether there is a connection between*

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[17] State of knowledge on biological effects at 40–60 GHz https://goo.gl/gbBKHL

[18] US Military Active Denial System http://jnlwp.defense.gov/About/Frequently-Asked-Questions/Active-Denial-System-FAQs/

[19] C. R. Physique 14 (2013) 402–411

[20] US Department of Interior letter and background: http://www.ntia.doc.gov/files/ntia/us_doi_comments.pdf

unusual (generally unilateral) tree damage and radiofrequency exposure." They found significant differences between the damaged side of a tree facing a phone mast and the opposite side, as well as differences between the exposed side of damaged trees and all other groups of trees in both sides. They found no tree damage in low radiation areas. The scientists concluded, *"Statistical analysis demonstrated that electromagnetic radiation from mobile phone masts is harmful for trees."*[21]

- Studies show insects are harmed by radiation: Food collection and response to pheromones in an ant species exposed to electromagnetic radiation found exposure to radiation caused colony deterioration and affected social insects' behavior and physiology.[22] Oxidative and genotoxic effects of 900 MHz electromagnetic fields in the earthworm concluded radiation caused genotoxic effects and DNA damage in earthworms[23].
- Mobile Phone Induced Honey Bee Worker Piping. The study abstract states,*"The worldwide maintenance of the honeybee has major ecological, economic, and political implications."* Cell phone RFR was tested for potential effects on honeybee behavior. Handsets were placed in the close vicinity of honeybees and the sound made by the bees was recorded and analyzed. The information revealed that active cell phone handsets induced the bees worker piping signal. *"In natural conditions, worker piping either announces the swarming process of the bee colony or is a signal of a disturbed bee colony."*

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[21] Radiofrequency radiation injures trees around mobile phone base stations. https://www.ncbi.nlm.nih.gov/pubmed/27552133?dopt=Abstract#

[22] Food collection and response to pheromones in an ant species exposed to electromagnetic radiation https://www.ncbi.nlm.nih.gov/pubmed/23320633

[23] Oxidative and genotoxic effects of 900 MHz electromagnetic fields in the earthworm Eisenia fetida. https://www.ncbi.nlm.nih.gov/pubmed/?term=23352129

SB 649 is an unnecessary gift to the telecom industry.

Respectfully submitted on July 6, 2017:

/s/_____
Sandi Maurer, Director
EMF Safety Network
PO Box 1016
Sebastopol CA 95473

/s/_____
Mary Beth Brangan, Co-Director
Ecological Options Network
PO Box 1047
Bolinas CA 94924

UNIVERSITY OF CALIFORNIA, SAN DIEGO UCSD

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Beatrice Alexandra Golomb, MD, PhD
Professor of Medicine
UC San Diego School of Medicine
9500 Gilman Drive, #0995
La Jolla, CA 92093-0995
Phone: 858 558-4950 x201

August 18, 2017

To whom it may concern,

I urge in the strongest terms that you vigorously oppose California SB 649.

If this bill passes, many people will suffer greatly, and needlessly, as a direct result.

This sounds like hyperbole. It is not.
My research group at UC San Diego alone has received hundreds of communications from people who have developed serious health problems from electromagnetic radiation, following introduction of new technologies. Others with whom I am in communication, have independently received hundreds of similar reports. Most likely these are a tip of an iceberg of tens or perhaps hundreds of thousands of affected person. As each new technology leading to further exposure to electromagnetic radiation is introduced – and particularly introduced in a fashion that prevents vulnerable individuals from avoiding it – a new group become sensitized to health effects. This is particularly true for pulsed signals in the radiowave and microwave portion of the spectrum, the type for which the proposed bill SB 640 will bypass local control.

Mechanisms by which health effects are exerted have been shown to include oxidative stress (the type of injury against which antioxidants protect ,see optional section below), damage to mitochondria (the energy producing parts of cells), damage to cell membranes[1, 21], and via these mechanisms, an impaired "blood brain barrier"[3-5] (the blood brain barrier defends the brain against introduction of foreign substances and toxins; additionally, disruption can lead to brain edema[6]), constriction of blood vessels and impaired blood flow to the brain[7], and triggering of autoimmune reactions[8, 9]. Following a large exposure, that depresses antioxidant defenses, magnifying vulnerability to future exposures, some persons no longer tolerate many other forms and intensities of electromagnetic radiation that previously caused them no problem, and that currently cause others no problem. But this group deserves – nay needs -- the right to be able to avoid these exposures.

Affected individuals not only experience "symptoms" that "merely" cause them distress and suffering, when they are exposed – symptoms like headaches[10, 11], ringing ears[10, 11] and chest pain[10] from impaired blood flow, heart rhythm abnormalities[10, 11], and inability to sleep[10, 11]. These symptoms arise from physiological injury. Moreover, **many experience significant health problems that can include seizures[11], heart failure, hearing loss[12-14] and severe cognitive impairment[11, 15].** The mechanisms involved are those also involved in development and progression of neurodegenerative conditions including Alzheimer's disease[16].

Fully half who were employed when their problems developed lost their job because of the problem, among participants of a survey we conducted. They reported that their condition had cost them up to 2 million dollars to date. Many had lost their homes. A number became homeless, and have swelled the ranks of so-called "EMF refugees"[17-19]. Among those affected, many were previously high functioning individuals – engineers, doctors, lawyers. The best and the brightest are among those whose lives – and ability to contribute to society –will be destroyed. High profile individuals with acknowledged electrohypersensitivity include, for instance, Gro Harlem Brundtland – the former 3-time Prime Minister of Norway and former Director General of the World Health Organization[20]; Matti Niemela, former Nokia Technology chief[21]; as well as the wife of Frank Clegg[22], who formerly headed Microsoft Canada and is current head of Canadians for Safe Technology[23].

Each new roll-out of electromagnetic technology for which exposure is obligatory, swells the ranks of those who develop problems with electromagnetic fields (EMF).- particularly following a significant exposure to pulsed radiowave-microwave radiation, and particularly when people have no ability to avoid it.

Many state that they didn't give credence to the problem (if they had heard of it at all) **until they themselves fell prey to it.**

This is not a psychologically driven condition. Multiple objective physiological changes reflecting mechanisms of injury have been shown in persons with this condition[24, 25].

The role for oxidative stress, that has been shown in innumerable studies (below)**, is affirmed by evidence of a link of this condition to genetic variants in antioxidant defenses**, that are less avid in defending against oxidative stress[307]. People cannot manipulate their genes, to produce such an outcome by suggestibility.

An analysis by a University of Washington researcher showed that most studies funded by industry reported failure to show physiological effects. However, most studies without such industry bias affirmed effects. This is redolent of findings shown in medicine[26], regarding which the former editor in chief of the BMJ (the British Medical Journal), Richard Smith, noted, based on findings of a study, "This {result} suggests that, far from conflict of interest being unimportant in the objective and pure world of science where method and the quality of data is everything, it is the main factor determining the result of studies."[27]. So where articles deny injury from nonionizing radiowave-microwave radiation, there is commonly a stake aligned with financial benefit from such denial.

Those who are affected are in desperate need of *protection* by our elected officials. They need creation of safe spaces and housing, and roadways to allow travel, not removal of any prospect of one; protection of local rights to make decisions - **not removal of any recourse or ability to avoid what injures them**. They are far more strongly in need of protections than a great many protected classes – their problems arose due to actions of others, against which they were given no control – *and can be reversed,* in most cases, if the assault on them is rolled back. Through no fault of their own, and in some cases against their will (e.g. before opt out was permitted with smart meters), they were subjected to an

exposure that has altered their lives as they knew them, and forced them – needlessly - to the margins of society.

Let our focus be on safer, wired and well shielded technology – not more wireless.

This legislation, if passed, and the resulting unrestricted roll-out of this technology, will predictably and directly injure and disable a new group, and add depth of suffering to those already affected.

In other spheres we abridge freedoms to protect the vulnerable few. We require that every schoolchild be vaccinated, supposedly to protect the vulnerable few who may not respond effectively to a vaccine. The need to protect the vulnerable group is deemed to be so great that it justifies the decision to abridge individual rights.

In contrast, this bill seeks to abridge individual freedoms, and local rights, in the service of *harming* a vulnerable group, and creating a new one.
(The common factor appears to be that in both cases, the direction is aligned with a powerful industry that influences political decisions.)
Luckily, no abridgment of individual rights and freedoms is required to protect,t here.

If any group can opt out (such as, I understand, firefighters*)[28]; **then *every* group deserves that equal right**. Others should not be second class citizens, subject to fewer protections.

It would go far to helping this cause if anyone complicit in promoting or passing the legislation (and then after that, *their* families) were required to be the first subjected, for a substantial test period, to the *greatest* amount of exposure that anyone *else* (and their families) may be subjected to, when new policies of this type are rolled out. It will still not do them equal damage; because they may not represent the vulnerabilities that others will have; but such a policy might help them to think twice. *That* is a bill I would strongly endorse.

Most who are now affected – were not, until they were. This may become you – or your child or grandchild. Moreover, if you have a child, or a grandchild, his sperm, or her eggs (all of which she will already have by the time she is a fetus in utero), will be affected by the oxidative stress damage created by the electromagnetic radiation, in a fashion that may affect your future generations irreparably.

It was noted above that, among survey completers, fully half of those who were employed at the time they developed electrosensitivity, lost employment *due to* this problem. (This may understate the scope of the tragedy, since this most-affected group may be least likely to be able to respond to an online survey.) **Many who previously had no problem navigating in the world are now restricted from access to basic services** like hospital care, post offices and libraries because of these problems. With each new introduction of technology that exposes many to yet a new nondiscretionary source of electromagnetic radiation, particularly (but not exclusively) that which emits pulsed radiation in the radiowave-microwave part of the spectrum, a new group of people are affected; and the suffering of those who are already affected increases greatly.

Please, defend the public and our future. Protect the rights of the individual and the locality, against a form of incursion that will lead to serious harm to some – and set a terrible precedent. **Vote no on California SB 649**, and urge that everyone else do the same.

Sincerely,

Beatrice Alexandra Golomb, MD, PhD
Professor of Medicine
UC San Diego School of Medicine

*****Comment on the fire fighter exemption:"The legislature granted an exemption from SB 649 to the firefighters who requested it for health reasons. Throughout California firefighters have long complained of often disabling symptoms from cell towers on their stations. Cities frequently rent out space on fire stations to add to city revenue. …Symptoms experienced by the firefighters have included neurological impairment including severe headache, confusion, inability to focus, lethargy, inability to sleep, and inability to wake up for 911 emergency calls. Firefighters have reported getting lost on 911 calls in the same community they grew up in, and one veteran medic forgot where he was in the midst of basic CPR on a cardiac victim and couldn't recall how to start the procedure over again…Prior to the installation of the tower on his station, this medic had not made a single mistake in 20 years. A pilot study (2004) of California firefighters showed brain abnormalities, cognitive impairment, delayed reaction time, and lack of impulse control in all 6 firefighters tested (https://ecfsapi.fcc.gov/file/7022117660.pdf). This study led to the overwhelming passage of Resolution 15 by the International Association of Firefighters in Boston in August 2004. Res. 15 called for further study and was amended to impose a moratorium on the placement of cell towers on fire stations throughout the US and Canada."[15, 28]
Clearly, others who experience similar problems also deserve protections.

Optional – More on the Science

There is a robust literature showing that electromagnetic radiation, including in nonionizing frequencies, and at *levels*[29, 30] *below* those that are cause thermal effects (heating) – causes physiological effects, injury, and cell death –not only in humans but many animals and plants[3, 7, 31-49]. Unsurprisingly, industry has sought – against the tide of evidence to the contrary - to maintain that radiation must be ionizing or heating to cause injury.

Scores or hundreds of studies show that radiation, including specifically radiowave-microwave spectrum radiation, and including low-level exposure, can impair antioxidant defenses, increase "oxidative stress" (free radical injury) and damage mitochondria, the energy producing parts of cells[1, 2, 34, 50-6930, 70-104105-13646, 137-171]. These effects occur with ionizing and nonionizing radiation, at thermal and subthermal levels. (Indeed, much or most of the damage by ionizing radiation, and radiation above the thermal limit, occurs by mechanisms also documented to occur without ionization, and below the thermal limit.) These

mechanisms cohere with the mechanisms documented to play a role in symptoms and health conditions that are reported in those who are electrosensitive – extending to seizures[172-176], heart failure[177-184] and cognitive decline[5, 32, 57, 108, 185-195].

These mechanisms have known involvement in induction of **brain cancer, metabolic diseases like obesity and diabetes, autism, autoimmune disease, and neurodegenerative conditions**, conditions that have exploded. In each case these have been linked, or presumptively linked, in some studies to electromagnetic radiation[8, 9, 16, 34, 196-219].

Such radiation also has effects on sperm[33, 100, 220-228]; and the DNA of sperm[229] (consistent with recent news reports of marked recent declines in sperm counts and function)..

Such radiation also has toxic effects in pregnancy[230], to the fetus and subsequent offspring[231-235] including at low levels[236], and is tied to developmental problems in later life, including attention deficit and hyperactivity[31, 235-241]. It is critical to defend pregnant women (and eggs of girls who may at a later time become pregnant) from exposures with such toxicity.

Electromagnetic radiation across much or most of the spectrum (not excluding visible light) has been shown to depress levels of melatonin[40, 72, 242-252]**,** which is best known for its role in sleep (and indeed, impaired sleep is the most consistent symptom in affected individuals[10, 11]).

Melatonin is in fact a critical antioxidant that defends the body against harm from *many* toxic exposures[253-266] **including electromagnetic radiation itself** [61, 66, 67, 82, 101, 107, 118, 121, 138, 144, 151, 204, 249, 267-284]**- reducing the oxidative stress** that is implicated in cancer, metabolic diseases like obesity and diabetes, autism, autoimmune disease, bipolar disorder and neurodegenerative conditions, and that also plays a role in heart attack and stroke[9, 285-329330-343].

Radiation, and specifically radiation in the radiowave-microwave portion of the spectrum can also depress levels of other critical antioxidant systems that also defend the body against chemical, radiation, and other sources of injury. These other antioxidant systems include the glutathione system, superoxide dismutase and catalase[81, 102, 115, 116, 233, 344-358] - which are also involved in defending against health problems.

This suggests that depression of antioxidant defenses due to electromagnetic radiation may magnify risk of chemically induced health effects (and depression of antioxidant systems due to some chemicals may amplify risk of harm from electromagnetic radiation). Indeed just such effects have been reported[359, 360].

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Harry Vere Lehmann
Principal Attorney

Law Offices of Harry V. Lehmann PC
4 Vineyard Court
Novato, California 94947

Area Code 415
Telephone: 897-2121
Facsimile: 898-6959

July 6, 2017

VIA PRIORITY MAIL and/or HAND DELIVERY and/or EMAIL

Assemblymember Marc Levine
5135 State Capitol
Sacramento, CA 95814

Re: Mass casualties are likely in District 10 from passage of SB 649

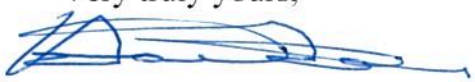
Dear Assemblymember Levine,

Senate Bill 649, a decision now before you, will likely result in mass fatalities in your District including children, who due to skull development levels and other factors, are more subject than adults to the effects of the carcinogenic cellular radiation which will saturate the homes in your District if this Bill is passed. Like you, I distain inflammatory phases as such are so often deployed by emotionally over-loaded people with incomplete capture of the facts and science. Yet, directly relevant to SB 649, the Toxicology Program of our federal National Institutes of Health has shown through their $25 million study, as announced on May 27, 2016, that cellular wireless radiation affects human tissue via non-thermal means and the formation of glioma, the cancer cell which results in glioblastoma (the brain cancer that kills people). Brain cancer killed four of my colleagues and friends which is what led me several years ago into dedication to our work educating consumers about smartphone proximity through www.greenswan.org. SB 649 is not about smart phone proximity but the constant radiation from the 50,000 towers from SB 649 presents a moral necessity to oppose this Bill. SB 649, now pushed by an industry which makes huge donations and contributions, is being advocated to wirelessly supplant cable as a main means of delivering TV, et al. Senate Bill 649 should be stopped in its tracks in order to protect the residents of your District. At the very least, SB 649 should be put on hold pending further study, as our federal Senate decided regarding the federal version of the same Bill, called S-19, pending further study.

As a trial lawyer, I have specialized in engineering and scientific proof civil cases since 1983. As nearly as I can tell I've personally handled approximately 1,600 civil cases, including certified class actions like the Chevron aviation gasoline matter (new engines for 1647 aircraft), the Mobil Oil AV-1 matter (overhauled or replaced engines for 850 aircraft, mostly twins), and I served as part of the plaintiffs' team in the Yuba Flood Cases, which after far too long settled against the State for $423 million, as well as many hundreds of other cases, some of them also involving large groups of plaintiffs. I am not important, or by contemporary standards wealthy. Like you, I want facts, not hot-headed opinion from

some alarmist. Rather, our opposition to SB 649 is not grounded in emotion, but strongly grounded in science. If this Bill is allowed to be passed by our Assembly and is then signed into law, mass Crimes Against Humanity will likely result due to radiation exposure, ***as you are hereby notified and warned***. Dated May 23, 2017, a 14 page submission on this subject was made to the already-overworked Senate Appropriations Committee, which presentation was composed of a detailed and annotated letter over my signature and supported by a Declaration under Penalty of Perjury by Mr. Paul McGavin. Paul and I are mere two of the large of California residents who, like representatives of cities and counties, oppose SB 649. Rather than taking up your time with more of my own words, and having given you this legal Notice of the likely consequences from the passage of SB 649, I respectfully advise you of said letter submitted to Senate Appropriations to your attention, and hereby incorporate that May 23rd Appropriations letter herein by this reference as though more fully set forth. Copies of that letter and Declaration should be immediately available to you from Senator Lara's office if you so request. I note in closing the additional factor that if SB 649 becomes law in California, the State will face ruinous financial loss from the resulting ADA complaints, all as set forth in that incorporated letter. **A selection of sources for your study is listed below**. Thank you.

Very truly yours,



Harry V. Lehmann

A small selection of articles and sources related to non-ionizing radiation and health:

https://ehtrust.org

http://scientists4wiredtech.com

http://scientists4wiredtech.com/2017/03/rfr-hazards/

https://www.niehs.nih.gov/news/newsletter/2016/6/science-highlights/cellphones/index.htm

http://www.motherjones.com/environment/2016/05/federal-study-links-cell-phone-radiation-cancer/

http://www.cbc.ca/news/cell-tower-radiation-harmful-to-humans-study-1.958047

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http://www.latimes.com/business/la-fi-cellphone-5g-health-20160808-snap-story.html

Law Offices of Harry V. Lehmann PC

Harry Vere Lehmann,
Principal Attorney

4 Vineyard Court
P. O. Box 1846
Novato, California 94948-1846

Area Code 415
Telephone: 897-2121
Facsimile: 898-6959

Via facsimile of even date and Federal Express.

July 19, 2017

Ms. Jennifer Galehouse, Deputy Chief Consultant
Assembly Appropriations Committee
State Capitol, Room 2114
Sacramento, CA 95814
Via 10 page fax: 916-319-2181
& Federal Express overnight

Re: 1. Incorrect data given in Telecom testimony regarding Liability: The State faces liability exposure from SB 649

2. Whether exquisitely planned for this inevitable result, or 'just lucky' for Telecom, SB 649 once deployed will have the effect of shifting massive Industry liability to the State of California.

Dear Ms. Galehouse -

The liability-shift component of the SB 649 issue set has not been previously addressed. I didn't see the underlying liability-shift until after the testimony last Wednesday. The liability-shift consequence of SB 649 is a difficult point to see, but essential to be recognized. This letter is divided into two sections, the ***GENERAL OVERVIEW*** which appears next below presents the gist in three pages, and then a larger section titled ***IN GREATER DETAIL***. Because the liability shifting aspect of this analysis was not seen by the undersigned until after the close of testimony on July 12th, and because the Appropriations Committee hearing on SB 649 is only a week away, and because this analysis implies possible billions in losses to the State, ***an Appropriations issue***, this is an initial overview of the situation in the expectation that seasoned and competent unbiased legal analysis will be made of the most startling of the two issues here addressed, before passage of this Bill: In-depth legal analysis is encouraged.

GENERAL OVERVIEW

This letter reaches the conclusions stated through several vectors of analysis but bottom line this boils down to two core points: **1.** During the hearings on SB 649, assurances were given by industry that the telecom companies would be the only entities affected by liability from radiation injuries. That is not true. Rather and instead, through SB 649 California faces potential liability for any injuries claimed to have resulted from the allegedly 'small cell,' antennas delivered to our residents from SB 649. **2.** More profound in implication if true, and difficult to see, **there is a heretofore non-disclosed sequella from SB 649**; the potential transfer all financial liability for cellular injury cases from the telecom corporations ***to the State***.

The State of California faces liability for damages sustained from Senate Bill 649

Typically any very serious or catastrophic injury case will be handled by experienced counsel - I believe any experienced lawyer who has been long engaged in plaintiffs work with governmental entities would agree with the following points, not one involves rocket science:

1)The defendants in a lawsuit do not get to choose whether to be sued. That choice is made by plaintiffs' counsel. There is no way for any industry representative to honestly claim that the State will not be sued for such injuries.

2) Once the involved cellular antenna box is attached to the involved governmental utility pole, for several reasons including the Doctrine of Fixtures as often used in tenancy situations, a melding takes place, and plaintiffs counsel will allege, as is consistent with the law, that the melded unit as a whole is Public Property.

3) Though plaintiffs can't sue the State for negligence or other Common Law causes of action, under our Government Code suit can be brought for Dangerous Condition of Public Property.

4) These *public* utility poles are demonstrably 'Dangerous' within the meaning of Government Code 835, because the radiation they emit has been scientifically proven to be carcinogenic, and the radiation is damaging to the human biological system. This is most dramatically proven by the $25 million NIH study released on May 27, 2016, showing that cellular radiation causes the malignant cancer cell glioma, which is what causes the deadly brain cancer: glioblastoma.

5) The State of California, as a result of the Firefighters's Exemption, or Firehouse Exemption as it is alternatively called, is, a unique development, ***admitting the dangerous nature of the about-to-be-built 'small cell,' system, because, as a matter of provable Legislative Intent, the firehouses were exempted due to health concerns.*** So our Legislature is poised to create at least 30,000 different pieces of Public Property while in one fell swoop also branding each one as Dangerous. Other examples supportive of this point will appear below, in the discussion of the liability-shifting aspects of SB 649.

Senate Bill 649 can shift liability exposure from the telecom industry to the State of California.

The most important purpose of this letter is to alert Assemblymembers of previously undisclosed economic consequences which to the undersigned appear legally very likely to ensue from the passage of SB 649. State lawyers with extensive trial experience should evaluate what is said here and advise Appropriations and the Assembly whether the warnings here represent real issues. The consequence of greatest concern is that passage of SB 649, contrary to appearances, ***will result in the mass transfer of***

liability for cellular microwave injury from the telecom industry to State government, with $Billions involved. Whether this here-disclosed consequence is the result of a brilliant and intricate multiple-stage legal stratagem by the best lawyers that Telecom could retain, or whether the industry just got lucky, the result for the State of California will be the same, financial ruin. Consider the following factors:

1. The State can't be sued for 'negligence' or other basic common-law theories of relief, and Claimants can only sue as allowed in the Government Code.

2. The main CA Government Code section which is virtually always pled by all experienced public entity lawyers is Dangerous Condition of Public Property, Government Code 835. .

3. If the 'taking,' of county and city properties in SB 649 is allowed, then what next follows when the cell tower is affixed to the publicly-owned utility pole, due to the 'fixtures,' doctrine and other legal reasons, is the merger of antenna and pole into Public Property. This is a complex issue with other criteria supporting the same Public Property finding.

4. Through the 'Firefighters Exemption' to SB 649, prohibiting cellular antenna construction near where firefighters sleep, based on health grounds as pushed by their unions, ***the State is acknowledging that its new melded-exposure property is Dangerous***.

5. As a result of the above the enabling legislation makes the resulting Public Property Dangerous in character in the light of Government Code 835, which in turn makes lawsuits against the State much easier.

6. There is now overwhelming evidence of DNA and cellular damage from radio-frequency EMF as emitted by cellular phones and towers. If you have doubt about this, set up a debate between me and the best they've got. See prior letters, notably of May 23rd to Senate Appropriations, with integrated sworn Declaration of McGavin.

7. It is a matter of well-established public record that the international re-insurance industry has long refused to insure any aspect of the telecom industry for injuries caused by cellular devices or installations. There is no net.

8. ***The only avenue left to the cellular industry, other than just honestly facing up to this mess and helping us solve it, is to shift the legal responsibility to government***.

9. Though good challenge may be on the horizon, the current stance of federal law under the Telecommunications Reform Act of 1996 it is not possible to prevail against a cellular company for liability for a phone made in roughly the last two decades.

10. Seasoned and competent counsel, where injuries occur of a sort consistent with EMF injury to DNA, including glioblastoma as indicated by glioma from the NIH study, will file suit against responsible corporate entities, broadly, and also sue the State of California. Right now many serious lawyers avoid this area due to the 1996 Telecommunications Reform Act. However the practical immunity offered to telecom under the act is conditional upon compliance with FCC standards, and there are now material means available to show that none of the currently marketed smart phones meet FCC standards when measured *as actually used in the field*, namely up against the face.

11. In the instance of the successful bar to civil prosecution which is currently provided by said industry-inspired 1996 Act, and in a State where 'joint and several liability' means that a 5% liability contributor has 100% of financial responsibility from a loss, ***the result of the combination of the factors stated above is that in the instance of suit, including 'friendly,' all financial burdens from cellular injury are shifted to the State of California, under the results from SB 649 as here-projected, through exercise of the federal regulatory bar to such prosecution of cases against the telecom industry.***

I assert no position as to whether the stream of results capsulized above will arise from the prior formation of an intricate plan from very smart lawyers, or whether the industry just 'got lucky,' in regard to the seemingly inevitable consequences of signing SB 649 into law. It doesn't matter, but when you look five or six moguls down this hill, the financial crash is inevitable. The above introductory language has provided the essential elements. A more detailed section below will provide related details.

IN GREATER DETAIL

Below is described in numerical sub-sections is the financial burden-shifting hidden in SB-649, which exists regardless of whether that liability-shifting aspect is inherent in the Bill from actual intention or lucky accident: The effect of S-649 being signed into law and then the antennas deployed thereunder, will shift liability for massive numbers of cellular device injuries from industry to Government.

1. Under SB 649 and as a result of the corporate 'taking' of municipal, county, and State property, in the form of forced corporate seizure of previously publicly owned utility poles, the cellular antenna placed thereupon by such installation, including in real estate law, become an integrated 'fixture,' of said public property, in several ways legally indivisible therefrom. Other examples to the point of shared conduct imbuing with Public character arise from joint venture, etc. ***Once industry puts these antennas up on public poles, all risks and injuries from such antennas will be from a Dangerous Condition of Public Property, as defined in Government Code 835***. The resulting Jury Instructions can be seen at CACI 1100.

2. In California law, state, regional and local governments cannot be sued for 'negligence.' Rather, the basis for which a suit may go forward against the State or an element thereof will, and must, be grounded in a statutorily prescribed Cause of

Action. Most commonly in these governmental tort situations, seasoned counsel will file, first, a Governmental Tort Claim alleging **Dangerous Condition of Public Property**, and thereafter, post-denial of the claim, the central plead liability theory of most such cases is just that, **Dangerous Condition of Public Property**, as provided for in Government Code 835.

3. It is established by clear and convincing evidence that cellular microwave broadcasts have adverse health consequences. The recent positive demonstration of the causation of malignant glioma (thus glioblastoma) cells from cellular energy in perfectly Faraday protected environments from our National Institutes of Health was only the most recent of similar and earlier findings. Much of these data and citations thereto have been provided to all Senators and Assemblymembers, including from my own letters. There can be arguments about varying danger of differing exposure routines, ***but the fact that the danger exists is overwhelmingly demonstrated***, including by exposure standards for technicians engaged in cellular tower work. The epidemiological proof of non-thermal effect on the human biological system is now beyond reasonable dispute, as shown for just one example in the work of DeKun Li, the senior epidemiologist from Kaiser, Oakland, showing statistically significant increases in asthma and obesity in children of mothers who experienced higher level of EMF exposure during pregnancy. The data are readily accessible to all legislators. ***With the Firefigthers Exemption, the Bill itself is stating that the installation of small cell antennas on poles is "Dangerous,"*** else no reason fo the Exemption.

4. It is well established in publicly available records and news reports that the re-insurance industry has refused, for decades, to insure or even defend manufacturers or carriers or others in telecom against lawsuits on behalf of persons claiming to have been injured by cellular radiation exposure. Therefore, the Telecom industry, now the largest dollar industry in the world, is on the high wire without a net. **The industry likely has no insurance for injuries from cellular radiation, and it is not the proper job of the People of the great State of California to insure industry for that exposure.**

5. ***In this situation, lawyers for the industry have almost certainly been tasked with examining ways through which the burden of this possible cellular injury exposure could be deflected onto other entities***. These people are too smart not to have seen this far down the road.

6. Recent news reports have speculated that SB 649 may result in as many as 50,000 new cellular towers in California; in his recent correspondence Dr. Joel Moskowitz has indicated a range of between 30,000 and 50,000: The total may not reach 50K in the near term, as there are no provisions in SB 649 to truly extend past the Divide in rural areas. If for illustration we assume the lower number, it becomes a simple math problem: LEGISLATIVELY CONFESSED DANGER x 30,000 PUBLIC POLES = 30, 000 SEPARATE INSTANCES OF DANGEROUS PIECES OF PUBLIC PROPERTY.

We have all heard allegations of people jumping on municipal transit buses immediately post crash, seeking to participate in recoveries. I think that is actually very uncommon, but recognition of tort opportunity will be easier here as these are stationary Dangerous Public Properties, which conveniently bring the carcinogenic radiation right into your living room, especially if you live in a crowded building, which with 5G exponentially expands the field density to which residents are exposed, the broadcasts not being cohesive EMF, each neighbor is affected by his or her neighbor's use of 5G.

7. Our Assembly should insist upon detailed legal analysis before passing SB 649: Under current constructions of The Telecommunications Reform Act of 1996, the companies are protected from liability, whereas it appears that the State is unlikely to benefit from the liability avoidance aspects of the 1996 Act. This is a complex area, to be further litigated, hopefully to correction for the benefit of the consumer, but there is a widely prevailing current legal view that current constructions of the Act protect the companies from any injury claims stemming from radio-frequency exposure. ***After the SB 649 cellular towers are up, and claims come forward, in any such resulting suits, until the law is more to the benefit of consumers than is currently the apparent case, where manufacturers and Telecom companies and the governmental body are all sued, and telecom can dodge out, there is a substantial legal argument the government entity involved cannot.*** This Bill sets up the State for massive losses by putting it in the place of an insurance company insuring against losses based on cellular exposure.

8. Causation will be a core issue of proof in the wave of Claims and then Complaints on this issue that is inevitable to come, given the science. Ultimate adjudication may be by Court, which is all we have at this point, or perhaps as some now visualize, something akin to the National Vaccine Injury Program, which has dispensed billions of dollars to injured claimants since its inception. Given that with the Firefighter's Exemption the State is acknowledging that its conduct of putting these antennas on every block is intentional conduct being pursued despite clear repeated science-based Notice of the risk. Here, if SB 649 goes forward, despite the repeated clear warnings of harm that have been given in submitted written records, a Court may also reasonably conclude that such further engagement in such State activity is an Extra-Hazardous Activity. The legal point that derives from this is that in Extra-Hazardous Activity the scope of Proximate Cause will be allowed to expand, a factor which puts the State at risk.

If the Assembly goes forward despite this risk, bankruptcy of the State of California can be reasonably expected to result. Just think of the testimony that we've recently heard, on July 12th, from residents who have suffered from and are still fighting brain cancer, which they attribute, with science-based cause, to extensive long term up close exposure to cellular telephony. Thus, if there is a phone-based lawsuit, where the claim derives from an area of SB 649 saturation, the lawyers involved, in order to meet the ordinary standards of care of the work, will be compelled to sue the State. It is further noted that the effective immunities enjoyed by mobile telecom service providers and manufacturers under the 1996 Act are conditional upon the device(s) involved radiating

within the FCC designated range of radiation values, yet our measurements in Palo Alto, for example, show that the strength of the allegedly 'small' cellular devices on poles there are in some instances *multiples* of the approved safety standards for human tissue saturation. In the urban context, with many households, including children, using 5G where cable used to work, most residents of dense apartment buildings will receive radiation saturation not only from what people (multiple TV's) in *their* apartment, but also from broadcast, which is not a cohesive signal, as received by nearby neighbors.

With wide-spread increasing rates of long term use, the inevitable will be put forward based upon alleged injury from a cell phone: Because of the cumulative nature of DNA damage, even with only episodic breakage increases, an upward numerical trend of DNA strand breakage percentage over time appears inevitable if SB 649 is allowed to pass. In normal balance against damaging influences, our bodies rely upon the abilities of the human biological system to self-repair, including at a DNA level, but where the capacity for repair is exceeded by direct exposure (*as distinguished from environmental exposure)* from a carcinogenic radio source, the potential for increased levels and rates of mutagenic process can reasonably be expected to occur as a result of the overwhelm of such repair capacities: Once the entire urban and suburban areas are densely saturated with so-called 'small cell' 5G (+ ?) cellular signal, and additionally given the overlapping EMF factors involved, seasoned counsel would always name the telecommunications company, the manufacturer, the seller, the service provider, and now the State, based on SB 649-rooted liability exposure. The State will be permanently exposed to liabilities so numerous and great that all other California state government programs will suffer, from roads to good policing, to schools, to public safety, to pensions.

Our laws recognize both concurrent cause, and joint and several liability where the injury resulted from multiple entities acting in concert. Joint and several liability also results in the instance of the concurring negligence of independent tortfeasors, such as in the classic Summers v. Tice context. **As is not uncommon in civil lawsuits, an entity with only a tiny factual contribution to the occurrence of the liability inducing event, say 5% of the negligence pie, under Joint and Several Liability *is liable for the whole quantum of the injury involved* in the instance of legal unavailability of the other defendants.** Therefore, if, post SB 649, there is a cellular device based lawsuit, and 5G radio-frequency saturation was present during time of injury recognition, then normal standard of care obligations, in most instances, would require the naming of that entity by name, if known, as a defendant. Due to the admitted Dangerous Condition of Public Property recognized as dangerous by the Firefighter's exemption) inherent in the melded 'small cell' 5G antenna/pole Public Property, if SB 649 passes, given Joint and Several Liability, if the companies are excluded from liability by federal law, then the State will be the full-paying defendant in such suits. Next discussed below is the question of causation, forced upon us by the looming nightmare of SB 649.

On the Subject of Causation

A science-compliant discussion of non-thermal causation of damage to people by cellular devices is forced upon us here by the incomplete physics analysis which industry lobbyists attempt to repeat in their rebuttal to claims of injury. After the Senate

Appropriations hearing which included SB 649, I was approached in the corridor by a lead lobbyist from a very major telecom company. He said to me, I paraphrase ". . .you know, Mr. Lehmann, in order to affect tissue molecules without heat, you have to move the neutrons . .and there's not enough energy in cellular signal to affect those neutrons."

The above-described exchange with this lobbyist is described in the 14 page letter and sworn Declaration that Mr. McGavin and I presented to the Senate Appropriations Committee. That kindlylobbyist was actually mis-stating the company line: Contrary to the above lobbyist's remarks, the long-stated industry position has not been about 'neutrons,' but rather that: 1) Cellular non-ionizing radiation doesn't have enough energy to directly modify an electron's shell position in an atom, *so that the valence of that atom cannot by such cellular radiation be directly changed*, and: 2) Therefore direct, non-thermal DNA damage to human tissue is not possible from cellular radiation because the energy involved is not sufficient to occasion molecular re-combination except via heat.

The industry position on the disclosed part of their physics to chemistry argument makes sense: That there is not enough energy in current or anticipated civilian cellular radiation to cause an electron to jump a shell position. However, this electron-shell-no-can-go routine is defective in its predicate: The industry position, choir sung by most industry engineers (not the late great Robert C. Kane), is predicated upon the incorrect assumption that the only mechanism of non-thermal damage is ionic forced change, meaning situations in which so much energy is by radiation placed into the molecules involved that over-loading of charge forces electron migration resulting in molecular re-combination, experienced as tissue damage.

Ionic-forced-immediate-direct chemical change, which *does* occur with ionizing radiation, does not occur with less powerful non-ionizing radiation from cellular devices. However, clear science shows that DNA strand breakage is occurring from the non-ionizing radiation from these sources. As you likely know, it is well proven scientifically that high frequency sound can, for example, shatter glass. The data indicate that DNA breakage is resulting from mechanical vibration of the DNA molecule as DNA molecules dissipate the energy which is undeniably pumped into them via radio-frequency EMF. In this regard, the 1983 interferometer findings of Swicord and Brown at the University of Maryland were mentioned in the 14 page compendium which submitted to Senate Appropriations, containing my 7 page letter and Mr. McGavin's Declaration, under Penalty of Perjury, which was also 7 pages, and which 14 page letter to Senator Lara, dated May 23rd, is integrated herein by this reference as though more fully set forth herein. It was found by Swicord/Brown's work that the addition of DNA salts to plain water, to a 7.43 percentage in the resulting fluid, ***caused a twenty-four fold increase in Specific Absorption Rate, and that this massive 24X change was non-ionic***, but rather 'acoustic,' meaning as a result of the mechanical receipt of vibration energy from the cellular frequency by the DNA molecular structure.

Swicord and Brown, as stated in their paper on their interferometer testing of SAR levels, were verifying prior peer-reviewed projections that this level of SAR change in DNA would result. It is my current understanding that Dr. Swicord was at FDA when that agency, which usually passes judgement on radiation-generating consumer products,

exempted cell phones, and then, as I understand it as informed opinion, Dr. Swicord lived out his remaining career at Motorola. So, bottom line, we have extreme vibrational change in DNA from cellular range radiation, namely a drastic 24 fold increase in Specific Absorption Rate. The importance of this repeated finding is best illustrated by the work of Dr. Henry Lai, when this work was published he was with the University of Washington School of Medicine I heard Dr. Lai's presentation of his experimental findings at the International EMF Conference in Stavanger, Norway, in late 2009, and later in Norway was honored to travel to and reside for a while in the mountains over Bergen with the world's top scientists in this field, including people at the level of Dr. Martin Blank of Columbia and Dr. Olle Johansson of the Karlinska Institute, Stockholm.

Dr. Lai's experiments unequivocally proved the fact of DNA strand breakage from cellular telephone radiation. So, once the reader understands that: 1) Through the interferometer work of Swicord and Brown at Maryland, 1983, that DNA change occurs via acoustic means, while also understanding that: 2) The work of Dr. Lai, showing that such cellular signal causes DNA breakage, then it may be responsibly suggested that the occurrence of DNA breakage, not by ionic means, but via acoustic receipt of the vibrational energy. That's how people are getting hurt. Plus the calcium ion findings, noted, supra, from the elegant work of Dr. Pall at the Washington State University, and propriety requires the mention of the ground breaking work of Dr. Andrew Galsworthy of Imperial College London, whose pioneering work regarding the stripping action of cellular and other microwave on intra-cellular calcium is forth in Dr. Galsworthy's March 2012 paper The Biological Effects of Weak Electromagnetic Fields - Problems and Solutions. As to vibrational fracture of the DNA molecule, see *also Electrosmog and autoimmunde disease*, by scientists Trevor G. Marshall and Trudy J. Rumann Heil. The core point sought to be communicated here is that the industry dirge; 'it can't be us, cause non-ionizing radiation can't force an ionic change,' is an incomplete as an analysis of cell damage causation, because it is a red herring of belief that has distracted the busy from seeing the actual causation.

Many environmental influences can contribute to the formation of the more serious illnesses. The book The Secret History of the War On Cancer, by epidemiologist Dr. Devra Davis is the best available professional source towards an understanding of the relationships between industrial toxins and health patterns in the population. This section on Causation is here only because the industry excuse sheds less light than smoke. By background, I have practiced trial based law for four decades, specializing in engineering and scientific proof cases since 1983. After the deaths of four friends and colleagues from brain cancer, I became a student of the EMF issues, to which issues myself and many others are dedicated to public education, including through our ongoing work at Green Swan, Inc.

SB 649 Seeks to Keep Cellular Telecom Off The Ropes at California's Expense.

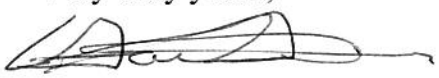
Telecom is giant and powerful, but the truth, science, ethics and the law are far more important than the $1.43 trillion that industry has poured into lobby efforts since 1998 (www.opensecrets.org). But even with all its massive funding, the industry has not been able to buy insurance for this industry regarding potential mobile phone casualties.

The re-insurance industry, giants like Zurich, Lloyds, long ago announced that they would not insure for personal injuries caused by cellular devices. As a result the telecom companies are at this point on their own. If they don't shift liability responsibility to another entity or entities, they face massive and potentially ruinous. Perhaps this led to a multiple stage, difficult to see legal tactic of risk shifting to the public. If something like this were going on, it would all of a sudden make a lot of sense if there were an *extreme rush* placed on this legislation. Senate Bill 649 mimics legislation that the industry tried to get through the federal Senate (S-19), which didn't work out for them, it was placed on Hold at the end of March, where it now remains, *and directly thereafter commenced this massive hard push to get California on board with the same 'seize the light poles' effort, to which obviously immense professional lobby effort is being devoted to an ongoing ongoing push for fast passage.* Normally, we could say, 'well, that's life, sometimes you've got to led the big dog eat.' But this situation is very different from ordinary because lives and souls are at stake here. This isn't a game or a hobby, this is serious.

Whether planned or not, after infrastructure is established resulting from SB 649, one crucial result ***is to transfer the financial burden of impending severe liability exposure from the industry to the government.*** In the instance of S-19, a substantially duplicate Bill now sensibly remaining on Hold at the federal Senate, the transference of liability exposure would have been to the federal government. With the failure of S-19 at the federal level the telecom industry went immediately to work in California. With the telecom industry having consumed a great feast at the restaurant of commerce, the effect of signing SB-649 into law would be to stick California with the tab for that very feast.

Lawmakers in California to insure that any legislation which is passed will not harm the public. Any member of our Legislature who, ***knowing that there is scientific evidence of harm***, votes for SB 649 will be no different than those in power over Flint Michigan, who knew of the health hazards in the water, and yet allowed that public health hazard to continue. However, in terms of the number of people to be severely harmed, the situation with SB 649 is far more severe even than what tragically happened in Flint.

Very truly yours,



Harry V. Lehmann

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Harry Vere Lehmann,
Principal Attorney

Law Offices of Harry V. Lehmann PC
4 Vineyard Court
P. O. Box 1846
Novato, California 94948-1846

Area Code 415
Telephone: 897-2121
Facsimile: 898-6959

Via facsimile of even date and Federal Express.

July 19, 2017

Ms. Jennifer Galehouse, Deputy Chief Consultant
Assembly Appropriations Committee
State Capitol, Room 2114
Sacramento, CA 95814
Via 10 page fax: 916-319-2181
& Federal Express overnight

Re: 1. Incorrect data given in Telecom testimony regarding Liability: The State faces liability exposure from SB 649

2. Whether exquisitely planned for this inevitable result, or 'just lucky' for Telecom, SB 649 once deployed will have the effect of shifting massive Industry liability to the State of California.

Dear Ms. Galehouse -

The liability-shift component of the SB 649 issue set has not been previously addressed. I didn't see the underlying liability-shift until after the testimony last Wednesday. The liability-shift consequence of SB 649 is a difficult point to see, but essential to be recognized. This letter is divided into two sections, the ***GENERAL OVERVIEW*** which appears next below presents the gist in three pages, and then a larger section titled ***IN GREATER DETAIL***. Because the liability shifting aspect of this analysis was not seen by the undersigned until after the close of testimony on July 12th, and because the Appropriations Committee hearing on SB 649 is only a week away, and because this analysis implies possible billions in losses to the State, ***an Appropriations issue***, this is an initial overview of the situation in the expectation that seasoned and competent unbiased legal analysis will be made of the most startling of the two issues here addressed, before passage of this Bill: In-depth legal analysis is encouraged.

GENERAL OVERVIEW

This letter reaches the conclusions stated through several vectors of analysis but bottom line this boils down to two core points: **1.** During the hearings on SB 649, assurances were given by industry that the telecom companies would be the only entities affected by liability from radiation injuries. That is not true. Rather and instead, through SB 649 California faces potential liability for any injuries claimed to have resulted from the allegedly 'small cell,' antennas delivered to our residents from SB 649. **2.** More profound in implication if true, and difficult to see, **there is a heretofore non-disclosed sequella from SB 649**; the potential transfer all financial liability for cellular injury cases from the telecom corporations ***to the State***.

Law Offices of Harry V. Lehmann PC

Harry Vere Lehmann
Principal Attorney

4 Vineyard Court
Novato, California 94947

Area Code 415
Telephone: 897-2121
Facsimile: 898-6959

Via fax: 916-319-2181

August 24, 2017

The Hon. Assemblymember Lorena Gonzalez-Fletcher, District 80
Chair, Assembly Appropriations Committee,
Care Of : Ms. Jennifer Galehouse, Deputy Chief Consultant
Assembly Appropriations Committee

RE: Due to multi-axial EMF crossfire, SB 649 will disproportionately injure the poor, in District 80, and in the rest of urban and suburban California.

Dear Assemblymember Gonzalez-Fletcher:

Due to multi-axial overlapping signal saturation, if SB 649 is enacted as intended, the negative health consequences will fall disproportionately upon the poor. Below are relevant factors supporting this fact:

1. One goal of installing 50,000 new cellular distribution antennas is that 5G customers will be able to receive the digital entertainment now provided by cable through the 5G network.

2. The cellular broadcast signals from these incorrectly-labeled 'small cell,' microwave transmitters are not cohesive, but rather spherical; not like a laser, more like a lightbulb.

3. With the 5G approach a single local microwave broadcast antenna can carry many different programs simultaneously.

4. When non-coherent broadcasts are from the same or nearby towers, their signals will overlap, think of overlapping 3D Venn Diagrams, or like a yard lit by lights of many different colors from the same pole.

5. It is therefore unavoidable that such differing signals from the same (or separate and nearby local) 'small cell' 5G antennas will overlap.

6. The result of overlapping of non-coherent radio-frequency broadcasts is expanded signal concentration, ***with an increase in received signal density proportional to the proximity of recipient sites to each other.***

7. Anyone familiar with the lives of our more recently arrived Hispanic residents knows that their living situations tend to be more dense than the density experienced by financially secure residents. People of all races who live in assisted circumstances are in the same situation: The square footage in apartment units is proportional to what can be afforded.

8. For example, if on any given evening at 8 p.m. there are 16 units in an apartment building, and each one is viewing 5G digital entertainment, ***then <u>all</u> 16 units will be saturated from <u>each</u> of the non-coherent broadcasts being made from the 'small cell' antenna(s) involved.***

9. While there will also be increased signal density in apartments occupied by well-to-do residents, the radiation saturation experienced by the poor will be greater, because the units are closer together.

10. Poorer residents, in addition to living in more tightly packed units, due to financial circumstance will sometimes live with more people in each unit than the well-to-do. With 5G entertainment, an increase in people using tablets in any given also increases saturation density.

11. Well established science already supplied to Appropriations shows that cellular radiofrequency non-ionizing radiation causes harm to the human biological system, including glioblastoma, and that this harm is caused in part by breakage of the DNA molecule strands as well as disruption of cellular calcium ion utilization. Even 'ordinary' single unit cellular phones will cause a kill-off of 50% of the sperm in a male who keeps a cellular device in his front pants pocket. A recent Israeli study showed a kill-rate at 47%. The poor will be hurt worse than people who live in single family homes far from the streets.

The above noted effects are not tied to race but they ***are*** tied to money and resulting density of occupation. People who are living in the most congested circumstances will experience far greater levels of signal density. My father was a truly great man who worked as a school custodian in his later years and I was working full time in a restaurant while a freshman in high school. I am glad to still see the world in many ways with the eyes of a person from the serving classes. This is a time when each of us, regardless of background, should recognize that the deployment of so-called 'small cell' 5-G will hurt the poor more than the rich. As a lawyer and as CEO of Green Swan, our advocacy company, I volunteer to debate this with whatever lawyer the telecom industry wishes to sacrifice for that process.

Very truly yours,

Harry V. Lehmann, as a lawyer
and as CEO of Green Swan, Inc.